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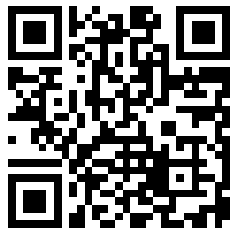

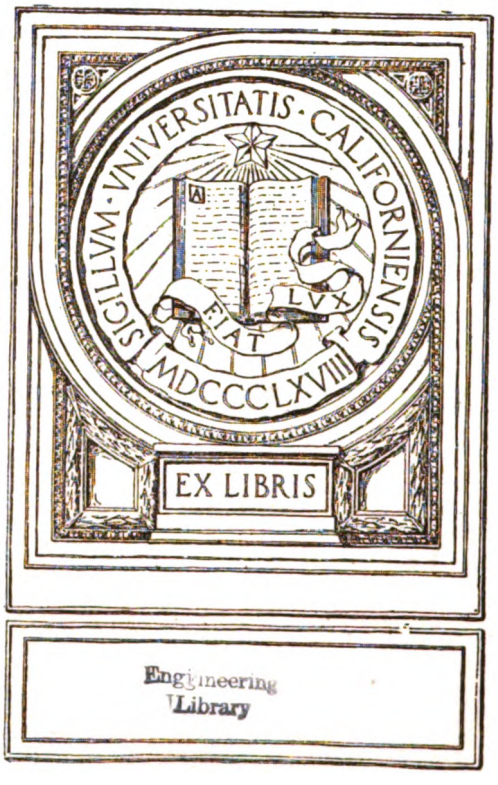

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THE WIRELESS WORLD AND RADIO REVIEW

PRICE 4D NET.

OCT 20 1924

GETTING RESULTS WITH OSCILLATING CRYSTALS

THE SUPER-SENSITIVE THREE-VALVE RECEIVER

THE POST OFFICE AND THE EXPERIMENTER

No. 268 [No. 1 Vol. XV]

No. 1. VOLUME XV.

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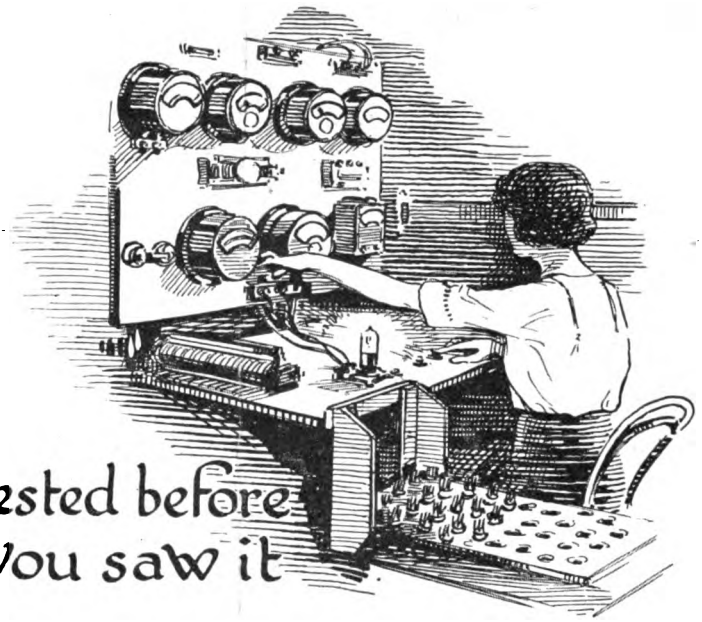

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The WIRELESS WORLD AND RADIO REVIEW

WHAT OF THE FUTURE?

OUR OFFER OF £500 TO DEFEND THE AMATEUR.

By THE EDITOR.

THOSE who were present to hear the address to the Radio Society of Great Britain delivered by Dr. Eccles, the President, on Wednesday last, will not easily forget that occasion.

Apart altogether from the actual words of the address, there was conveyed throughout a note of warning which amateurs will do well to heed. We have at last had brought to our notice in a forcible manner the present position of the amateur with a hint at what his future fate must be if determination and concentrated effort is lacking in the future. It is true that most of us who have made it our business to watch carefully events of the past year or two have realised that by gradual and sometimes apparently subtle means the amateur's position has been steadily undermined and weakened by those whose interests are antagonistic to the prosperity of the amateur or who, if not themselves antagonistic, have been coerced into that attitude by external pressure from powerful influences.

The time has passed when diplomatic and polite methods with the Post Office authorities can suffice to retain for the amateur the recognition and consideration which he has not only earned by his work and contributions to science but which is also his by right. The art of diplomacy is a weapon which should not be despised, but at the same time it is an indication of weakness if diplomacy is still resorted to in cases where its limitations have been made apparent.

The possibility is very naturally suggested that the necessity may arise for a test case to be fought by the Radio Society in support of the amateur's rights. *The Wireless World* has therefore offered to support the Society to the extent of Five Hundred Pounds in the event of such a case being brought to court.

Rather more than a year ago *The Wireless World and Radio Review* issued a word of warning when it became obvious that a change in the position of the amateur was impending, and in stating what we believed to be the situation at that time, we used the following words: "The amateur's war has not yet begun, but that it may commence at any moment and that it will be a fight for his very existence should be apparent to anyone who is watching closely events which concern the official position of amateur experimenters."

Perhaps a year ago these words may have seemed a little premature, but in view of present conditions in the amateur world it cannot be said that they exaggerate the situation to-day.

"What of the future?" we may ask, and "How can we avert these disquieting possibilities?" Only one solution presents itself. This is for all amateurs, whether as individuals or as collective organisations, to show complete unity of purpose in the efforts which must be made to maintain freedom for experimental work and enterprise. The amateur is far too numerous to be over-ruled and denied what is lawfully his right, if only he determines to assert himself.

However desirable independence of action may be on any other matters of amateur concern every individual and every party must give whole-hearted support to strengthen the position of the amateur community as a whole.

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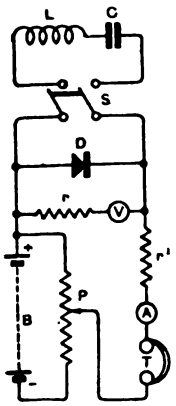

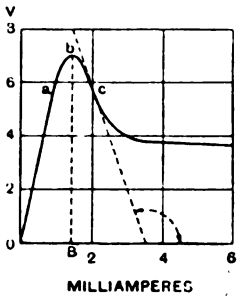

Fig. 1. Circuit for testing the aptitude of different crystals for generating or amplifying. Fig. 2. Characteristic curve of a suitable specimen of crystal.

THE CRYSTAL AS A GENERATOR AND AMPLIFIER.

By VICTOR GABEL.

THE first account published in English of the work of the Russian engineer, O. Lossev, in producing oscillation and amplification by means of crystals, appeared in *The Wireless World and Radio Review* of July 11th last, and since then references have been made to the same subject in other journals, both in this country and in America, but no additional information has been disclosed.

In this issue we have pleasure in giving publication to a further article, contributed by an engineer in Russia who is closely in touch with the work done by Mr. Lossev and others in that country. This article discloses all that has so far been recorded by way of observations on the action of the crystal and methods are given for testing crystals for oscillating properties, whilst in addition practical details are supplied on how to prepare crystals for the purpose. In addition, the author supplies a number of circuits and explains their operation so that the experimenter is provided with definite data to work upon in investigating further these extraordinarily interesting properties of the crystal.

APART from the immense possibilities which this epoch-making discovery of a new application of the crystal foreshadows, the experiments now being conducted may lead to some light being thrown on the theory of operation of the crystal during the process of detecting, a subject which is not yet fully understood. The pioneer work in these experiments is due to a Russian engineer, O. Lossev, and the following theories, which are the result of his experiments, may serve as a guide to those experimenters who are sufficiently interested to pursue the subject.

Selecting the Crystals.

It has been found that the best and most consistent results are obtainable when a zincite crystal is used in conjunction with a carbon contact, the oscillations once produced, remaining very stable and continuing without readjustment for indefinitely long periods, although the initial adjustment of the contact is rather more critical than is usual for ordinary detecting. The combination using a steel point also works satisfactorily. A copper contact used with zincite gives very poor results, whilst aluminium contacts are still less satisfactory.

The results obtained with other crystals, including galena, pyrites, carborundum and molybdenite, were very inconsistent, all of them oscillating badly or giving no results at all. It was found possible to obtain oscillations with the ordinary coherer,

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and even with a microphone contact, but they were very unstable.

Circuit for Testing the Crystal.

The following observations relate exclusively to zincite with carbon or steel points in contact. In order to understand the physical causes and the conditions necessary for the generation of oscillations with a detector contact, it is necessary to be acquainted with the characteristic of the crystal contact. The diagram, Fig. 1, shows how this curve can be obtained. The detector which is under test, is shown at *D*, whilst a galvanometer *A* measures the strength of the current which passes through the detector. A resistance *r* of about 100,000 ohms is for voltage measurement in conjunction with a galvanometer *V*, r^1 being a resistance of 1,000 to 5,000 ohms, and *B* a battery across which is shunted a potentiometer *P*, which should have a resistance of approximately 800 ohms. The inductance and capacity of the oscillating circuit into which the detector may be introduced by means of the switch *S*, are represented by *L* and *C* respectively. Employing this circuit, it is possible to determine the aptitude of different crystals for generating and amplifying.

It is, of course, well known that only certain points of a crystal are suitable for detecting and these must always be found by experiment. The same may be said concerning generating, for not only are oscillations only produced when contact is made with certain suitable points, but it is impossible to obtain even a compromise elsewhere. It might be thought that generating and detecting points would coincide, but in general, such is not the case, the circumstances favouring the production of oscillation not necessarily agreeing with those needed for efficient detecting.

Assuming that it is desired to find the generating point on a really sensitive crystal utilising the circuit shown in Fig. 1, it is necessary first to close the switch *S* and to adjust the potentiometer so that from about 6 to 12 volts is placed on the detector. By searching the different points on the crystal with the contact wire, the generating point will be found when a note is heard in the telephones. If the note remains pure and steady and does not change in tone during an interval of one minute, it is an indication that the point is a sensitive one. By cutting out the switch *S*, it will be possible to obtain the characteristic of the detector, showing graphically the relation between the applied potential and the current.

In order to obtain plotting points for the curve, the applied voltage is regulated through the agency of the potentiometer, commencing from zero and noting at each change on *A* the value of the current *i*, and on *V* the voltage. After reaching a current reading of about 5 to 6 milliamperes the measurements obtained can be marked on squared paper after the manner shown in Fig. 2. The current values are marked off along the axis of the abscissa, and the voltage along the axis of the ordinate. The resultant characteristic provides not only the direct corelation of *V* and *i* but also enables the detector to be regarded as a conductor possessing changing resistance properties.

By referring to the characteristic illustrated, it will be observed that the resistance between the points *O* and *a* remains approximately the same, after which it diminishes and becomes zero, when the current is equal to *O B*, whilst after the point *B*, for instance, at *C*, the resistance becomes negative. As a physical quantity, negative resistance has no significance, but the expression is accepted in mathematical physics where negative resistance is introduced as an algebraical quantity. It will, of course, be appreciated that the steeper the slope of the curve, the greater will be the change of resistance value. In view of this it may be assumed that the resistance of the generating point to weak currents is high and positive, after which it diminishes to zero and then becomes negative, the negative value increasing up to a certain point, after which it gradually diminishes again, as the curve shows.

If the current *i* passing through the detector is at first weak and then gradually increases, the detector will at first act as an ordinary positive resistance, that is to say, it will absorb the energy equal to i^2R. This will continue until the current passes over the point *B*, after which the absorption of the energy is equal to $i^2 (- R)$ or $i^2 R$ will become negative. When this state of affairs is reached, the energy will no longer be absorbed, but will, on the contrary, be re-

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turned or added to the output, so that the detector becomes a source of energy. In the event of an alternating current being present in the oscillating circuit *LC* (Fig. 1) whilst the potential is adjusted on the detector contact so that the detector works on the steep portion of the characteristic, then the detector commences to amplify the oscillations in *LC*, maintaining and increasing the oscillating current.

This effect can, obviously, only be produced when the detector is operating upon the negative portion of the curve. Thus, by suitably adjusting the applied potential, it is possible to attain such a state of balance that on the one hand the received oscillations are amplified, and on the other the amplified oscillations take place partly in the position of the negative and partly the positive resistance, when a simultaneous operation of amplifying and detecting can be obtained with the same crystal.

Practical Details for Heating the Zincite.

In the case of a bad specimen of zincite, the crystal may be greatly improved by being fused in an arc. This is best accomplished by placing the crystal on a carbon or iron

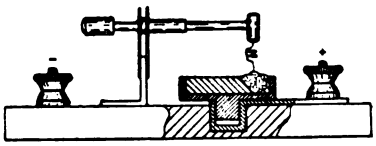

Fig. 3. A simple type of detector suitable for giving good adjustment.

plate, and sprinkling it with manganese dioxide. An arc is formed between the crystal and the carbon electrode, the process being watched through a dark glass. When the crystal is fused into an oval mass it is left to cool, after which the non-conducting crust which will be found to have formed on the surface, is cleaned off and the crystal is mounted into a cup with fusible metal in the usual way. The resistance of a crystal after being prepared in this manner is reduced about seven times.

The Crystal Holder.

For the convenience of the operator, it is advisable to pay special attention to the construction of the detector holder. A type recommended is that shown in Fig. 3. The contact wire, which should be twisted at the top into a spiral of about two turns, with a diameter of approximately 7 mm., should be made of hard steel not larger than No. 34 S.W.G. The crystal should be mounted in a cup the inner diameter of the cup being such that when the crystal is placed near the edge, and the cup rotated, fresh points of contact will be brought opposite the steel wire. It should be noted that the crystal is connected to the positive pole of the battery and the wire to the negative. As it is essential that the detector be protected from vibration, it would be advisable to place a rubber or cloth pad under it. When searching for the generating point the contact wire should not be pressed too hard upon the crystal.

Explanation of the Action of a Crystal Detector.

It is known that conductors possessing a negative resistance are generally able to self-oscillate. Chief among such conductors the arc, possessing a characteristic greatly resembling that of the detector, calls for special attention. The similarity of the two characteristics gives rise to the thought that the action taking place in the arc, and at the contact of the detector, must be similar in physical respects. Experiments and tests carried out by the author have partly corroborated this theory. As early as 1921 Hoffman surmised that the rectifying action of the detector might be explained by electronic discharges arising in consequence of a high gradient of potential at the point of contact. The formation of the arc may be represented as in Fig. 4, where a section of a contact greatly enlarged is shown.

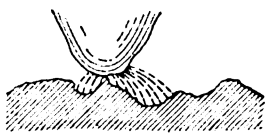

Fig. 4. An enlarged section of an arc, and it is suggested that the action of a crystal detector is due to an electron discharge, in some respects having similar properties.

As the surface of the crystal is always rough, it might happen that the end of the wire or the carbon might make contact on a

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sharp projection of the crystal adjoining a depression. Due to the fact that the ohmic resistance at the point of contact is very high, whereas the difference between the contact wire and the neighbouring points of the crystal is small, there may arise, if the current be strong enough, such high gradients of potential that electron discharges become possible. This suggestion is roughly outlined in Fig. 4. These discharges, although resembling the arc, differ from the latter in that the electrodes are not incandescent. For the formation of an arc the electrodes must be made red-hot either through previous mutual contact or through a discharge at high pressure. For the arc this "puncturing pressure" is about a hundred times higher than that needed for its maintenance.

The Effect of Temperature on Crystal Adjustment.

Experiments show that this relation in a zincite detector is between two and three. The difference may be explained by two causes—(1) the contact point is heated by virtue of its resistance to a temperature sufficient for a high potential to be unnecessary for a discharge to take place, or (2) the conditions favouring the discharge of electrons are different at such small distances. In experiments undertaken with the object of investigating this matter the generating contact was heated by means of a wire spiral heated by a current, the spiral being placed at a distance of one millimetre over the surface of the crystal. The results proved that the contact is very sensitive to changes of temperature, and a generating point found at normal temperature lost its properties when the spiral reached dull red heat.

A further result of these tests, however, was of considerable importance, for it was found that sensitive points discovered on the crystal when the spiral was at dull red heat possessed, under normal temperatures, a very high maximum voltage. At the same time the characteristic no longer indicated a negative resistance, and it became flatter and considerably lower, whilst the voltage, which corresponds to the highest point of the characteristic (point *B*, Fig. 2) fell much lower. Different characteristics taken at different degrees of heating showed in general that even small variations of temperature seriously affected the shape of the curves.

With one sample of zincite it was noticed that a current of 6 milliamperes was sufficient to make the characteristic lose its peak, which reappeared, however, after a time if the detector was not subjected to the influence of the current. This extreme sensitiveness to changes of temperature tends to confirm the suggestion previously made as to the difference in the conditions of the formation of the arc and the electron discharge of the crystal detector. The arc has a temperature of about 3,000 deg., whereas in the case under discussion it would seem that the action takes place at a temperature of not more than 100 deg.

There is, of course, the possibility that the electrodes of the detector may become heated by the action of the applied current. This observation suggests that care should be exercised when searching for a generating point to avoid passing an excessive current through the detector, as much time might be lost in a fruitless search under altered conditions. A current of 8 to 10 milliamperes can heat the points of contact to such an extent that the whole nature of the crystal may undergo a change.

Working the Crystal Contacts in a Vacuum.

In any event, such an overheated point would completely lose its property as a generator. It seems probable that, if the whole detector were placed in a high vacuum to prevent any of the electron energy being dissipated in air, the electron flow, and at the same time the oscillation energy, might be amplified.

[The concluding instalment of this important article, appearing in the next issue, will give numerous practical circuit arrangements.]

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THE POSITION OF THE SCIENTIFIC AMATEUR.*

LATEST DEVELOPMENTS UNDER THE WIRELESS TELEGRAPHY REGULATIONS.

By Dr. W. H. ECCLES, F.R.S. (President).

THE Radio Society and its Affiliated Societies comprise every kind of amateur—the home constructor who has fallen a victim to the fascination of making or improving tuners and amplifiers, the ripe enthusiast who welcomes morse as much as music and constructs reflex circuits and other modern marvels, and the matured transmitter who fishes in the ocean of space and learns the ways of the waves in our ever-changing atmosphere. By uniting all these the Societies will surely gain in strength as time goes on. At present the Radio Society consists of about 800 ordinary members and over 200 Affiliated Societies and is governed by a Council and by a General Committee.

THE INFLUENCE OF BROADCASTING ON THE AMATEUR POSITION.

The advent of broadcasting has greatly augmented the ranks of the amateurs, especially those interested in building and experimenting with receiving apparatus. As broadcasting flourishes so will the number of amateurs increase. It is inevitable that a large proportion of these amateurs will in due time desire to supplement their knowledge of receiving apparatus by actual work with transmitting apparatus. We hope to see them join the Societies early and climb through the various stages into the Transmitter and Relay Section and thereby enter the ranks of the *élite* in the amateur movement.

We of the Society think that one of the most lasting benefits of the spread of broadcasting—a benefit much less ephemeral than the music and the speeches—lies in the stimulus it is giving to the study of electrical things; and from this point of view broadcasting is an immense force attracting the quicker minds of every country towards physical science. We think this is highly commendable because we know that the spread of a knowledge of electricity and the cultivation of electrical skill (for which there is no better medium than wireless) is in the widest sense of the utmost national value in this glowing morning of the electrical age of mankind.

Since the time when Admiral Sir Henry Jackson, my predecessor in office, gave the first autumn Presidential Address, the custom has grown up of employing the occasion to tell members and the public of the recent joys and sorrows of the Council. I shall take advantage of this custom to-night.

THE INTERNATIONAL CONGRESS IN PARIS.

First of all, I have to inform you that the Society had the pleasure last Easter of taking part in the International Congress in Paris, held under the Chairmanship of Mr. Hiram Maxim, which led up to the formation of the International Amateur Radio Union. Mr. Marcuse, the Hon. Secretary of the Transmitter and Relay Section, represented the Society in Paris and was elected to the International Committee which is to meet next Easter to draw up schemes for international amateur work. Since the formation of the International Union, Mr. Marcuse has been travelling in America and Canada. He came back with a message from the Canadian Radio Relay League, worded as follows:—

> "Please convey our greetings to the Radio Society of Great Britain with congratulations on their achievements. We also congratulate the Transmitter and Relay Section on their wonderful success in the transatlantic tests and take this opportunity of expressing our desire for a stronger affiliation between Great Britain and the Colonies for the general benefit of amateur radio."

A CURIOUS RESTRICTION.

Very shortly after these events the Post Office began to issue their permits to transmitters with new and unexpected restrictions printed upon them. The one striking directly

* Delivered on Wednesday, September 24th, 1924, at the Institution of Electrical Engineers.

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at the international co-operation of amateurs just described is numbered 7 on the printed permits. It reads :—

"Messages shall be transmitted only to stations in Great Britain or Northern Ireland which are actually co-operating in the licensee's experiments and shall relate solely to such experiments."

I will read to you what the *Electrician*, one of the most important electrical journals of the world, said about it :—

"A CURIOUS RESTRICTION.—The permits to transmit, which are now being issued by the Postmaster-General to wireless experimenters and amateurs, contain a condition and limitation which is likely to give a good deal of trouble and whose precise object is not altogether clear . . . . How is it to be ascertained that the energy transmitted is passing within the frontiers of Great Britain and Northern Ireland and no further ? . . . . Again, what exactly is the aim of the restriction ? If only experimental messages are sent there can be no objection to whoever will receive them, and in the possibility of reception in unexpected places lies a good deal of the use and interest of this class of work. But quite apart from these points, the imposition of such a restriction, except in so far as it relates to *what* is sent, seems to us unjustified, not the least because it may have a harmful effect on the development of radio communication."

I call attention to the words in this criticism :—"in the possibility of reception in unexpected places lies a great deal of the use and interest in this class of work." This is so obviously true that the Society got into touch with the Post Office in order to elucidate the matter. We are given to understand that the printing of the restriction on the permit was merely embodying a practice already recognised ; and that each experimenter desiring facilities for foreign communications should furnish particulars of the experiments and evidence of an arrangement for co-operation by a foreign or colonial station or stations. Our comment upon this is that it is impossible to make arrangements for receiving from unexpected places and acknowledging the receipt.

HOW THE RESTRICTION HAMPERS PROGRESS.

I think the restriction may have been conceived without information of the methods necessary for carrying out this very valuable wireless range finding. For example, during the past few weeks very strong signals have been received in London from a powerful amateur station in the Argentine. The right thing for any English amateur to do would be to reply instantly and endeavour to get into touch on the same wavelength after making sure that he would cause no local interference. If he succeeded and made records of the variations of signal strength, he would have contributed something to wireless progress. But, according to the new restriction, he would thereby be endangering his permit. As the *Electrician* says :—"What is the aim of the restriction ? If only experimental messages are sent there can be no objection to whoever will receive them." I agree. It makes no difference whatsoever whether a message is addressed by a Sheffield amateur to a man in the Shetlands or a man in Dublin, yet the latter would be a breach of the permit. It makes no difference because the same waves go forth in the same all-round way whatever morse call sign is put at the front of the message.

IS THE RESTRICTION DULY AUTHORISED ?

I cannot imagine that international amenities can be assisted by any restriction that asks a British amateur to turn a deaf ear to his brother amateur in other countries who is not under such a restriction and will not understand it. The Council have received so many protests from members all over the country that they have had to enquire under what Act of Parliament and for what national or other reasons this limitation of a licence-holder's liberty is imposed. They have found no answer and they have concluded that such a restriction would destroy one branch of research, would prevent the development of friendly relations between amateur workers in this and other countries, and would tend to isolate the British amateur from international co-operation with the rest of the active world.

THE AMATEUR AND SHORT-WAVE TRANSMISSION.

It may not be generally known that the volume of continental amateur transmission that can now be heard in this country from dusk to midnight is vastly greater than the whole volume of our own amateur transmission at all hours. At this point one cannot reiterate too forcibly that it was the

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amateurs who discovered the valuable properties of short waves across long distances. Up to three years ago the commercial companies and the experts thought that short waves were no use for long ranges. Then the amateur stepped in and bit by bit extended the range across which one could communicate with another. Two years ago, as a result of the Radio Society's transatlantic experiments, the incredulous ones looked into the matter. Then the engineers of the Marconi Company, by using larger powers and reflecting screens, developed the Beam system, which, it is hoped, will afford many parts of the Empire a service of high speed telegraphy. In view of these very recent triumphs of the amateur, this seems quite the wrong moment to introduce restrictions which will push the British amateur off this field of discovery and leave it to the amateurs of other nations.

THE WIRELESS TELEGRAPHY ACT AND ITS INTERPRETATION.

The restriction and the discussion have called great attention to the Wireless Telegraphy Act. The Act seems very clear and I propose to give you my reading of it. First notice that the expression "wireless telegraphy" is defined to mean any system of communication by telegraph without the aid of any wire connecting the points from and at which the messages for other communications are sent and received. The main object of the Statute is to protect the State monopoly of the electrical transmission of messages or communications between individuals. A second object is to establish control over the sending and receiving of messages inasmuch as transmission by wireless telegraphy was thought to be a possible source of danger to the State in certain events, especially war. Another object is to obtain such control as will minimise the interference of one user of wireless with another. All these aims are just and necessary. They are to be obtained by prohibiting persons from establishing any wireless telegraphy station or installing or working any apparatus for wireless telegraphy except under licence from the Postmaster-General.

Two very important provisos are made in the Act. The first, which governs the whole Act, is that "nothing in this Act shall prevent any person from making or using electrical apparatus for actuating machinery or for any purpose other than the transmission of messages." In other words, if the purpose of a piece of electrical apparatus is *not* the transmission of messages it need not be licensed. This provision is obviously a necessary one, for otherwise every piece of copper wire wound into a coil and every pair of metal plates fixed up as a condenser, would need to be licensed, which would reduce the Act to an absurdity.

The second proviso is that when a British subject wants a licence for the sole object of conducting experiments in wireless telegraphy, that is, in communication to a distance, a licence shall be granted to him as his right. But he must prove to the satisfaction of the Postmaster-General that his sole object is to conduct experiments; that is to say, he must not have the intention to transmit messages for money, must not intend to interfere with other users of wireless maliciously, and must not intend to do anything dangerous to the State. This is the amateurs' Magna Charta.

(To be concluded).

FORTHCOMING TRANSATLANTIC SHORT WAVE TESTS.

Reference has been made in a recent issue to the probability that long distance communication by amateurs on short wavelengths will produce some remarkable results during the coming autumn and winter. Notification has already come to hand of two or three cases where two-way transmission extending over considerable periods of time have been established between this country and the United States and Canada. That which last year was an achievement of a comparatively few individual amateurs in this country is this winter likely to be a fairly general experience amongst a large number of transmitters.

The Transatlantic amateur tests arranged to take place in October will be certain to arouse enthusiasm amongst those who hitherto have not made any determined effort to communicate over such great distances, and the experience that will be gained during those tests will no doubt result in fairly efficient communication being established during the rest of the winter by a proportionately large body of British amateurs.

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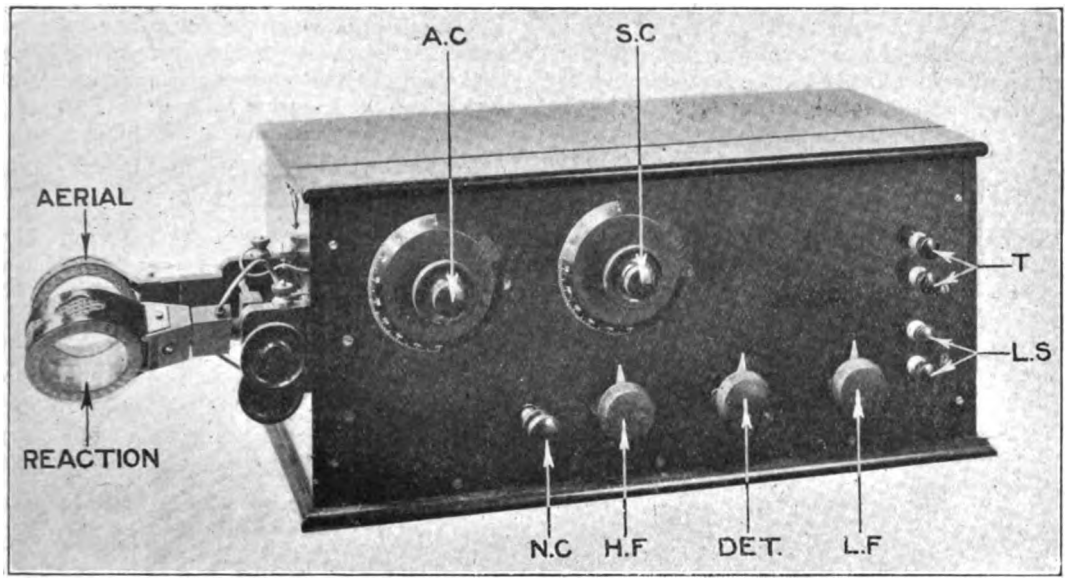

THE SUPER-SENSITIVE SET.

This three-valve receiver gives a remarkable degree of amplification with good selectivity. The receiver is simple to build and easy to operate.

By W. James.

THIS receiver has three valves, giving one stage of high frequency amplification, rectification, and one stage of speech frequency amplification. Telephones may be connected to the detector or a loud speaker to the last valve.

The valve employed in the high frequency stage is a Marconi-Osram D.E.5 B, a new valve which has a voltage amplification factor of 20, and an impedance of 25,000 ohms. The valve requires a filament current of 0·22 ampere at 5 volts, and the anode current is only 1 milliampere when the anode voltage is 80 volts and the grid voltage zero. It appears to be a much better valve for high frequency amplification than a general purpose valve (such as an "R" type), even though the latter has been specially chosen for H.F. work. For instance, it consumes about one-third of the filament power, has a much lower impedance, and has an amplification factor about 2½ times that of an R type valve.

I have found it advisable to employ a circuit which can be adjusted to neutralise the effects of the capacity which exists between the elements of the valve and between the wiring. One effect of capacity coupling is to pass energy from the anode circuit to the grid circuit. This acts in much the same way as ordinary magnetic reaction, which might, for example, be provided by correctly coupling a coil connected in the anode circuit to one connected in the grid circuit. The energy which is passed from the anode circuit to the grid circuit increases the signal strength, which is a desirable thing so long as the amount of amplification can

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be controlled. But with ordinary methods of amplification adjusted to give good efficiency, strong oscillations are usually generated when the anode and grid circuits are tuned to the same frequency. Thus the oscillations appear in the aerial, and are radiated to the annoyance of other listeners.

In addition, speech is distorted when the circuits of the receiver are oscillating, or on the point of oscillating.

METHODS OF OBTAINING GOOD HIGH FREQUENCY AMPLIFICATION.

There are two good methods of arranging the circuits in order that the effects of the unwanted capacity coupling may be minimised. These have been fully described in previous numbers of this journal.* The receiver described below is connected in such a manner that either of the two methods may be employed.

A holder consisting of a piece of ebonite with five valve sockets is wired in the circuit, and plug-in units for various wavelengths may be fitted in this socket. The plug-in unit consists of a holder having five valve pins, and carries two basket coils, which form a fairly closely coupled high frequency transformer. The two schemes of connection are shown in Figs. 1 and 2.

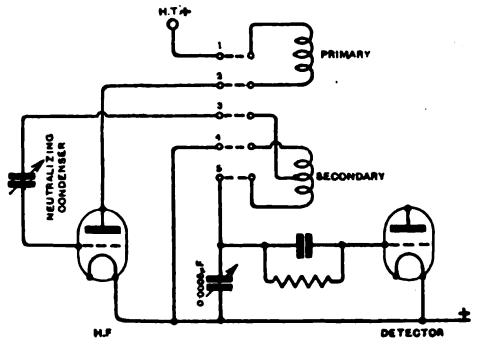

Fig. 1.
This figure shows one method of connecting the high frequency transformer to the holder. The holder has five pins which fit in five sockets, marked 1 to 5.

In Fig. 1 one basket coil (which forms the primary winding) is connected to pins 1 and 2, and the second basket coil (which forms the secondary winding) is connected to pins 4 and 5. Pin 3 is connected to a point on the secondary winding. It will be observed that the sockets in the holder are wired in such a way that when the holder is fitted in the socket the primary winding is connected between the anode of the first valve (H.F.) and the positive terminal of the high-tension

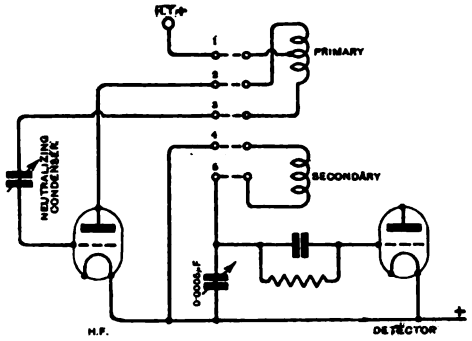

Fig. 2.
Another method of arranging the high frequency transformer. With this arrangement the primary winding has a centre tapping. In the arrangement of Fig. 1 the secondary winding is tapped. See also the photographs.

battery, and that the secondary winding is connected across a tuning condenser in the grid circuit of the detector valve. One side of the tuning condenser is, therefore, connected to the grid condenser and leak, and the other side to the positive side of the filament. To minimise hand effects, the moving plates are connected to the point of fixed potential—that is, the filament. Socket 3 is connected to one side of a small capacity variable condenser, and the other side of this condenser is joined to the grid of the high frequency amplifying valve.

When the coils of the high frequency transformer are suitably arranged as regards the ratio of turns of the primary and secondary windings, the direction of the windings, and their connection in the circuit, it is possible to make adjustments of this small condenser which balances the circuit. That is to say, when the condenser is correctly adjusted, no energy (or more correctly, a negligible amount of energy) is passed from the anode circuit to the grid circuit through capacity coupling between these circuits. Without the special connections and the small adjustable condenser the valve would probably oscillate when the grid circuit of the high frequency amplifying valve and the H.F. transformer are tuned to

* June 25th, 1924, page 358.

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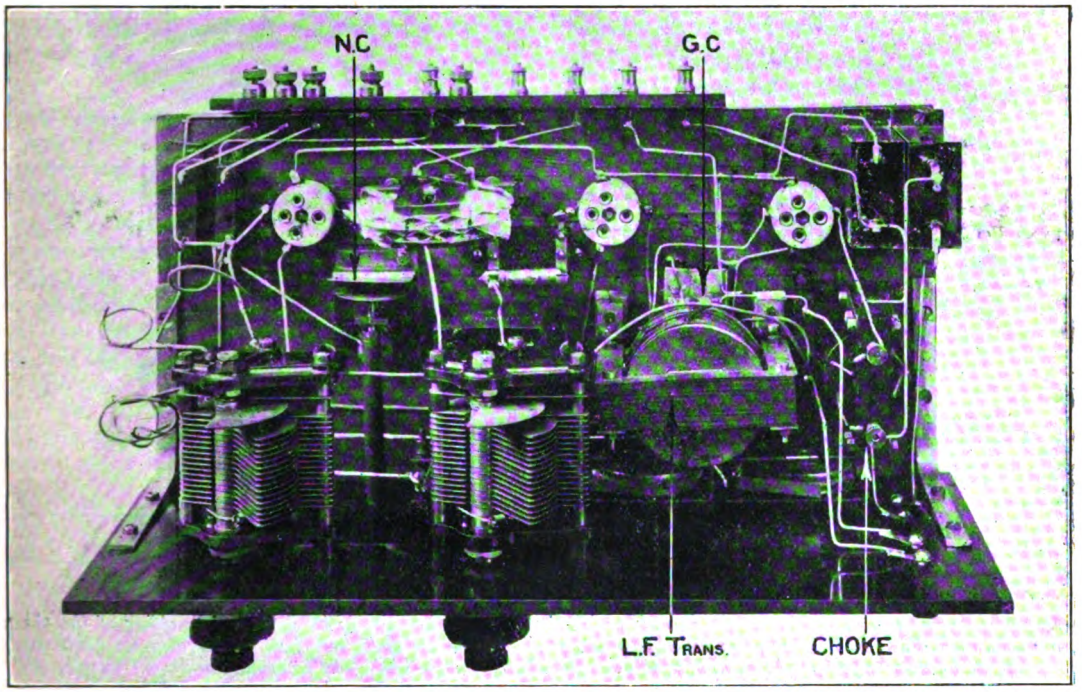
the same wavelength. By employing the condenser as shown in the figure, the effect of unwanted capacity coupling is neutralised, hence the balancing condenser is called a neutralising condenser. The advantages of this method of arranging the circuit are that tuning is simplified, a much higher degree of amplification is obtained, tuning is sharp, and oscillations which may be set up in the circuits of the detector valve by adjustment of its anode voltage, filament current or grid leak are not communicated to the grid to grid condenser and leak, end of secondary to filament, and the tapping to one side of the neutralising condenser.

A Second Method of Coupling the High Frequency Amplifier.

The second method of connection, shown in Fig. 2, involves the use of a larger primary winding, in which a centre tapping is provided. This tap is connected to the positive terminal of the high tension battery, the beginning of the winding going to the



View taken from above the three-valve receiver. N.C. = neutralising condenser. G.C. = grid cells.

circuit of the high frequency amplifier (and therefore do not reach the aerial).

To tune over the broadcast band of wavelengths, the primary winding may have 24 turns of No. 24 D.C.C. wire wound as a basket coil on a former 1½ ins. in diameter, with 13 pegs. The secondary winding may be another basket coil containing 66 turns of No. 24 D.C.C. wound on a similar former. A tapping should be made at turn 32 from the beginning of the winding. The coils are wound in the same direction, the beginning of the primary going to + H.T., end of primary to anode, beginning of secondary neutralising condenser and the end of the winding to the anode of the valve. To tune over the B.B.C. band of wavelengths, the secondary winding may have the same number of turns as before, and is connected in circuit as described in connection with the arrangement of Fig. 1. The primary winding may have twice as many turns, that is 48 turns, with a tapping at turn 24.

The Complete Circuit.

Referring now to the complete circuit of the receiver, Fig. 3, it will be noticed that a plug-in coil is employed in the aerial circuit,

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and is tuned with a 0·0005 variable condenser. The aerial may be connected through a fixed condenser of 0·0001 microfarad, 0·00025 microfarad, or direct to the top of the coil, by connecting it to one of the three terminals provided. When the 0·0001 microfarad condenser is in series with the aerial, the aerial circuit tuning is sharp, and a wider band of wavelengths may be tuned over with a given coil and the 0·0005 microfarad tuning condenser, than when either of the other two connections are employed. Tuning is not quite so sharp when the aerial is connected for the reaction coil. Careful use of the reaction coil gives a noticeable improvement in signal strength and selectivity, and is invaluable for long-distance reception. The reaction coil holder may be short-circuited while receiving local broadcast transmissions, it being remembered that beyond a certain point the effect of positive reaction is to reduce the quality of the telephony. It should also be remembered that as the reaction coil is directly coupled to the aerial coil, it is easy to set up oscillations in the aerial by increasing the coupling. To my mind, however, the

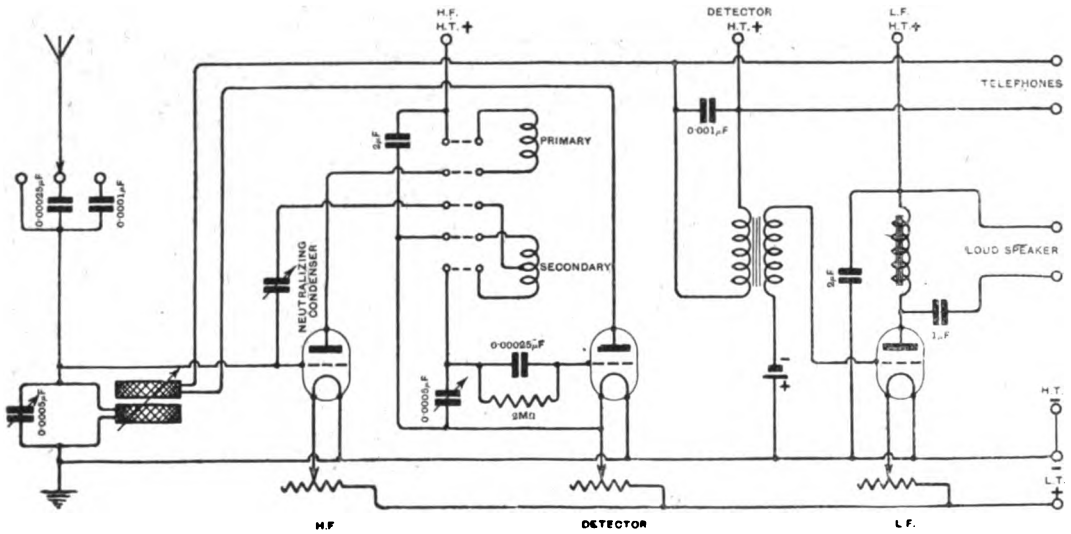

Fig. 3. Complete connections of the three-valve receiver. The aerial may be connected to either of the three terminals according to the degree of selectivity desired. A separate H.T. terminal is provided for each valve so that each valve may be operated under the most favourable conditions. The terminals marked "telephones" are connected in the circuit of the detector valve; the lower terminals marked "loud speaker" are connected to the last valve.

through the 0·00025 microfarad condenser, but signals are usually noticeably louder. The signals are generally strongest when the aerial is connected directly to the top of the coil. It should be remembered that selectivity is usually obtained at the expense of signal strength when the change is obtained by altering the ratio of capacity to inductance.

The aerial coil is accommodated in a two-coil tuning holder, the second holder being portion of the receiver which most requires the help of reaction is the aerial circuit. Full benefit is not obtained when the reaction coil is coupled to the anode coil or the inter-valve transformer. Hence the user of a wireless receiver should couple the reaction coil to the aerial coil and learn how to adjust his set so that oscillations are not set up in his aerial.

(*To be concluded.*)

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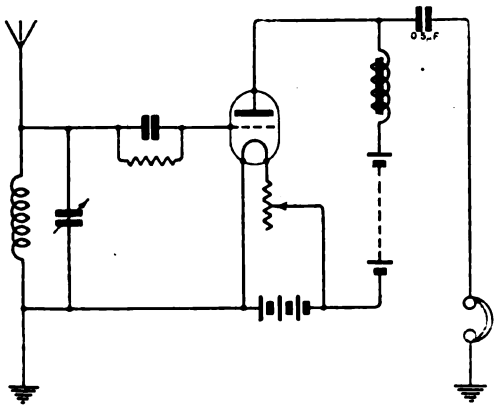
READERS' PRACTICAL IDEAS

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Telephone Receiver Extensions on a Single Wire.

WHEN extending telephone or loud speaker leads, the simplest method consists of running only one wire and picking up an earth connection. It will be seen from the accompanying circuit diagram that the H.T. battery is earth connected when a single circuit tuner is employed, whilst even with a loose coupled set it is usual to connect the battery side of the closed circuit to the earth lead. In using the circuit shown here it is always necessary to connect in the plate lead from the H.T. battery either an iron core choke coil or a pair of high resistance telephone receivers. A very indifferent or high resistance earth connection



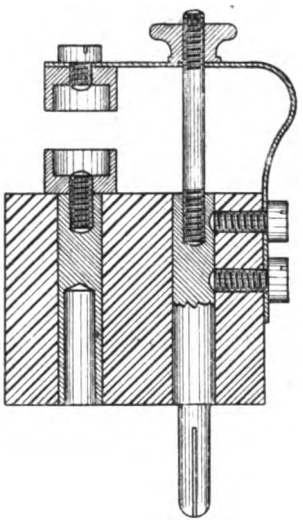
The telephone lead on the right in the diagram may be extended to pairs of telephones, picking up a local earth connection.

will suffice for the extensions, and in the event of telephone sets being used out of doors it is only necessary to drive the blade of a knife into some moist ground.

W. W.

Plug-in Crystal Detector.

THE convenience of constructing a crystal detector so that it can be plugged into circuit and interchanged with others is readily appreciated. It provides for



A useful plug-in detector of simple design.

reversing the connections of the crystal and moreover the detector can be entirely lifted out of circuit when the set is not in use, which prevents the crystal surfaces becoming damaged as would be the case were the detector lifted continuously on circuit.

A simple plug-in detector can easily be built up from a coil holder socket and the accompanying diagram gives the necessary constructional details which can easily be followed without further description.

W. H. G.

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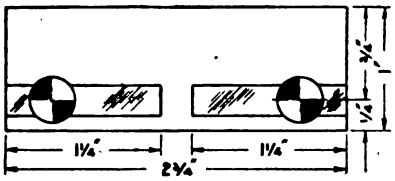
Fixed Condenser Connection.

SOME difficulty is usually experienced in making connection to the tags of the Dubilier type 600A condenser when used in temporarily laid out circuits. The method of twisting pieces of wire on to the tags is as a rule adopted and the connection so obtained is very doubtful and it is a very troublesome job to change one condenser for another of different value.

The simple device shown in the accompanying drawing will facilitate the making of a rapid and reliable connection. It consists of a piece of 3/16 in. or ¼-in. ebonite, 2¾ in. × 1 in. and carries a pair of terminals. These terminals hold down two pieces of hard



Clip for making contact with condenser tags.

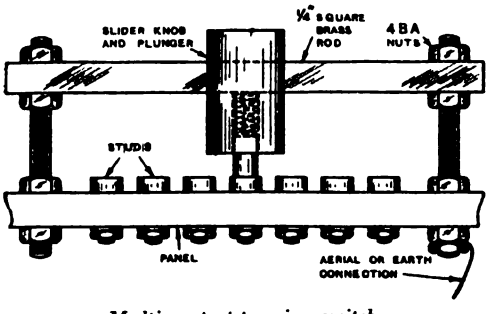
brass strip of about No. 20 S.W.G. in thickness and 1½ ins. in length by ½ in. in width. Using this device, the condenser tags simply slip beneath the brass strips, making a reliable contact.

J. N.

Sliding Contact Switch.

WHEN making up a multi-contact switch several difficulties present themselves, such as getting the spindle and bearing exactly a right angle to face of ebonite and truing up the studs and getting the arm to run smoothly. By arranging the studs in line, a rod and slider with spring contact can be utilised to traverse them. Constructional details are shown in the drawing.

J. S. B.



Multi-contact tapping switch.

Protecting Valve Filaments.

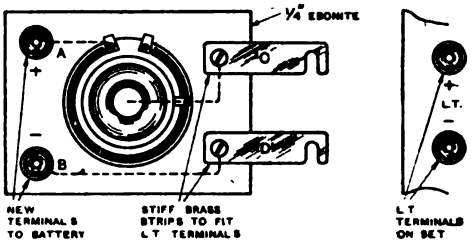
WHEN an additional filament resistance is connected in series with the filament battery leads of a multi-valve receiver, the following advantages will be gained :—

(1) The filament battery can be switched on and off gradually, thus reducing the shock to the filaments and without disturbing the setting of the separate resistances.

(2) Filament setting of a critical adjustment may be left undisturbed if required, switching off being done by the extra resistance, and thus compensating for any initial recuperation of the filament battery.

(3) Lower resistances of larger gauge wire may be used on the filaments of the individual valves, thus providing more critical adjustment. J. M. R.

BY fitting up as an external component a filament resistance in series with the L.T. supply a complicated set can be rendered suitable for use by unskilled operators.



Construction of a filament resistance panel for use in addition to the filament resistances already fitted to the set.

The resistance which is mounted as shown on a separate panel has terminals and connector clips. It serves to switch on the filaments of the set without disturbing the adjustment of the individual resistance.

J. T. D.

VALVES FOR IDEAS.

Readers are invited to send in descriptions of "gadgets" for inclusion in this section. To readers whose suggestions are accepted a receiving valve of standard make will be despatched. Letters should be addressed to The Editor, *Wireless World and Radio Review*, and marked "Ideas."

The many communications which have already come to hand are being dealt with as expeditiously as possible.

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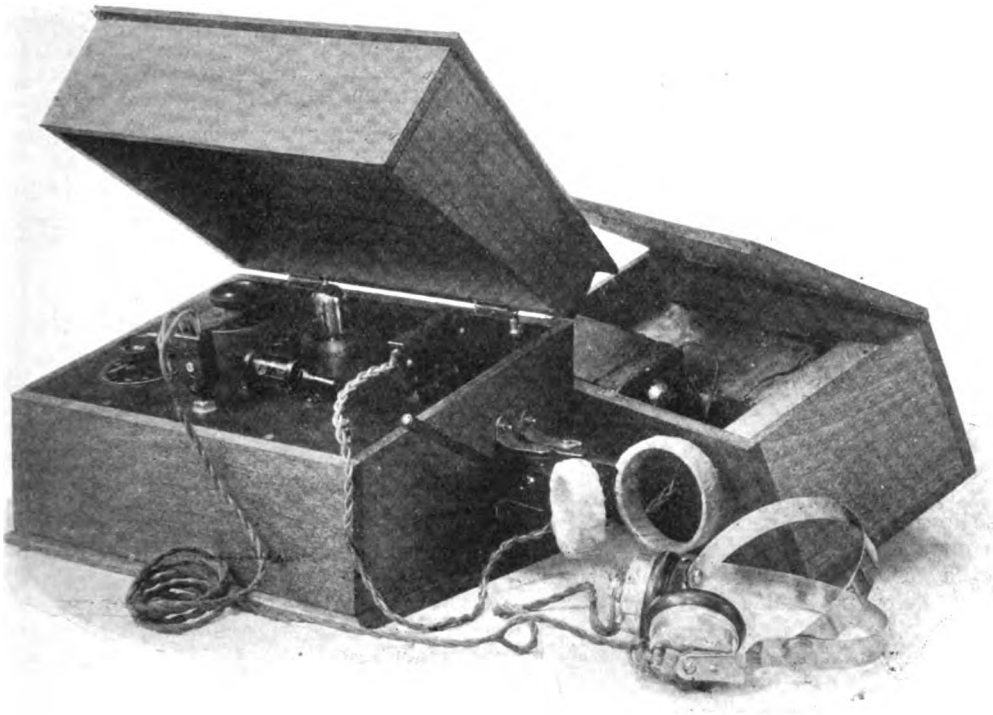

The complete set with containing box for dry batteries.

THE DRY CELL RECEIVER.

This receiver has been specially designed to obviate the difficulties of accumulator charging which beset many amateurs, particularly those resident in country districts where charging facilities are few and far between.

By H. J. Cooke.

THE purpose of this short article is to give some practical details of a set which is economical in filament current and which is simple to manipulate and easy to construct. It makes use of a circuit in which the valve is used both as a high and low frequency amplifier and detection is carried out by means of a crystal. The valve is of the 0·06 type and will, of course, work very well from a dry battery. The set is probably the most economical arrangement that can be built and is specially suitable for use where accumulator charging is a difficulty. It possesses a reasonably long range of reception accompanied by good signal strength.

Whilst appreciating that many difficulties arise in the operation of dual amplification circuits it will be found that some advantage is gained when using this circuit even on the wavelengths used for broadcasting, whilst for longer wavelengths its efficiency improves and thus very good reception can be obtained up to considerable distances from the new high power station, working as it does on 1,600 metres.

To facilitate construction of the set a complete list of components is given and is as follows :—

Ebonite panel 12ins. by 9 ins. by $\frac{1}{4}$ in.
Ebonite panel $4\frac{1}{4}$ ins. by $3\frac{1}{8}$ ins. by $\frac{1}{4}$ in.
14 ins. 2 B.A. screwed rod.

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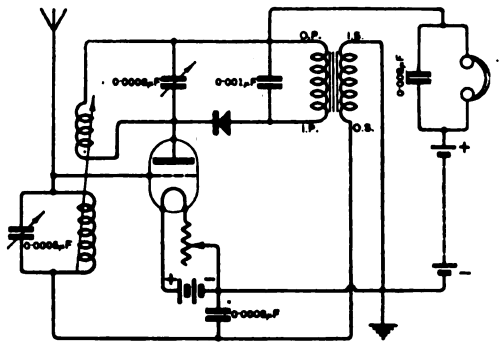
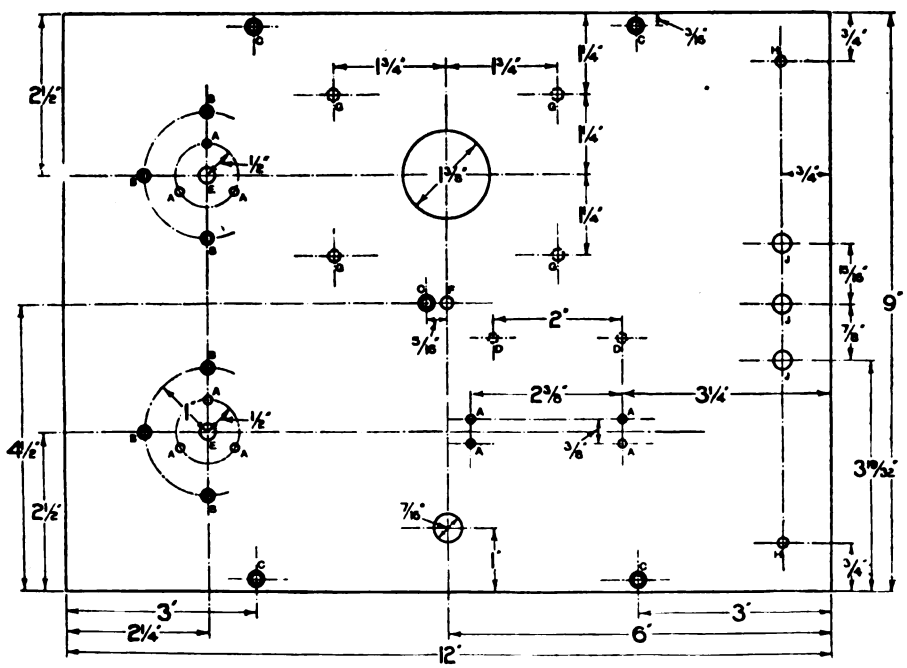
12 2 B.A. nuts.
0·0005 μF variable condenser.
0·0003 μF variable condenser.
Crystal detector.
Filament rheostat, 30 ohms.
Valve holder.
Plug and jack.
L.F. transformer.
2-coil holder.
Dull emitter valve.
Ever-Ready 4½-volt battery with 3-volt tap.
60-volt H.T. battery.
Fixed condensers, 0·002 μF, 0·001 μF, 0·0002 μF.
6 yds. No. 16 tinned copper wire.
2 brass hinges, 1½ ins. long by ⅝ in. wide.
Various wood and metal screws.

There is considerable latitude in the design adopted for the cabinet and the panel dimensions shown admit of liberal spacing between the components. Thus, if it is desired to make a compact set or to adapt the design to suit a particular cabinet which the reader may have to hand, it will be found quite an easy matter to bring the parts a little nearer together. Compact sets are usually difficult to construct and for this reason liberal spacing has been provided, and as a result the wiring up will be found to present no great difficulty.



The circuit is a simple one, making use of dual amplification and using a crystal for detection.

The construction of a cabinet for a wireless receiver is usually far more difficult than the construction of the set itself, for dimensions



Details for constructing the panel.

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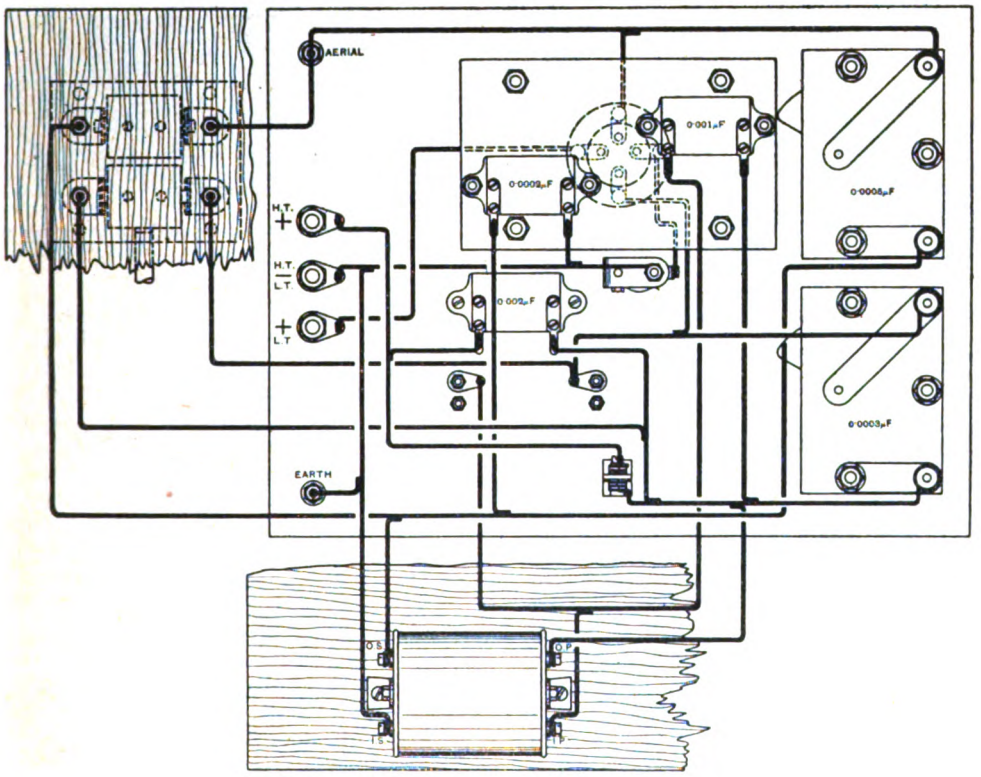
must be precisely worked to and all sides must be kept perfectly true and square. The reader is reminded that planed mahogany boards can be obtained from dealers in fret-work supplies and when accurately planed wood is used the cabinet construction will be very much simplified. In the construction of instrument cabinets, it is a good plan to leave certain of the dimensions a little larger than is required, so that after the sides have been screwed and glued together, projecting portions can be filed down flush and square.

Following the usual procedure for the construction of simple receiving sets the positions for the component instruments should be carefully marked out, using either a sharp pointed pencil on the matted face of the ebonite or the sharp point of the dividers on the underside. The marks are, of course, centre-punched to hold the point of the drill before drilling is proceeded with. It will be seen from the drawings that one large hole is required where the valve projects through the panel and this can be made by drilling a number of holes close together round a circle and filing down to a slightly larger circle with a half-round file.

The valve holder is carried on a separate sub-panel which is attached to the main panel with four pieces of brass rod tapped into blind holes on the underside and held in position by means of nuts. After rubbing down the panel in the usual way with carborundum cloth, assembly can be proceeded with. The valve holder with its sub-base should be mounted first.

Stiff wiring is the only permissible method of connecting up and a practical wiring diagram is given as a guide. It will be noticed that the tuning coils are attached to the side of the cabinet and there are many useful patterns of coil holder on the market already mounted on an ebonite piece for attaching to the instrument. The complete set, which is shown in the accompanying illustration, has been found to give very satisfactory results, being very cheap to run.



Practical wiring diagram.

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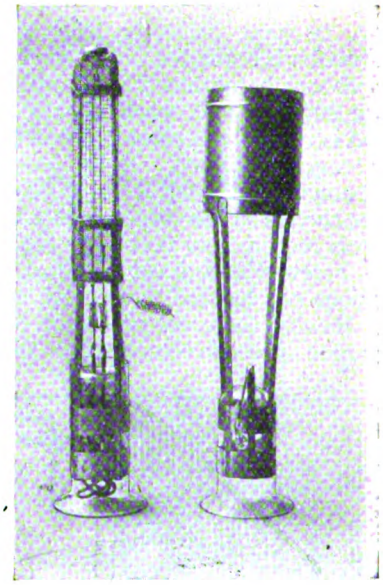
CONSTRUCTING THE VALVE.

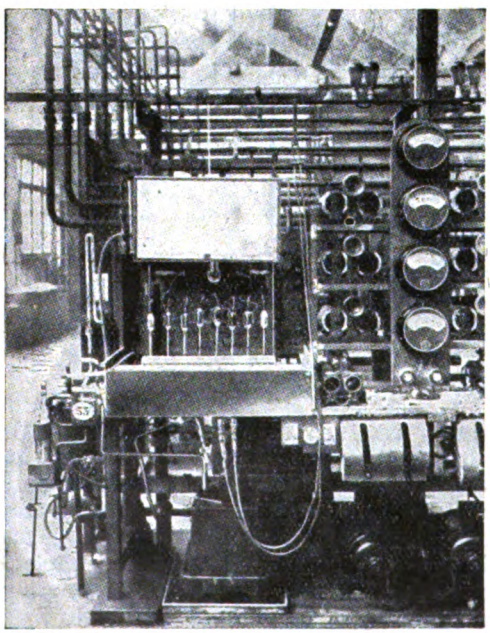
A VISIT TO THE MARCONI-OSRAM VALVE CO.'S WORKS.

A VAST amount of experimental work has been necessary in order to bring the thermionic valve to its present state of perfection. The early research work in this direction was conducted in this country by Marconi's Wireless Telegraph Co., Ltd., who acquired the patent rights of the valve from Dr. Fleming, who, as is well known, invented it in 1904.

It was during the war that the application and development of the valve was most rapid, and the General Electric Co., Ltd., devoted a portion of their Osram lamp factory at Hammersmith to investigate the problems involved in valve manufacture, and huge quantities of valves were produced for the fighting forces. The results of these experiences are combined in the M.O. Valve Co., Ltd., an organisation which has the joint advantage of the research laboratories of the General Electric Co., Ltd., and also the wide experience of the Marconi Company's engineering and research staff.



Electrodes for a typical transmitting valve.



Pump tables with eddy current heating equipment for fine filament valves.

The resources of the M.O. Valve Co., Ltd., are to-day devoted to the production of valves marketed under the name of Marconi Osram.

It is interesting to follow through the various processes involved in the manufacture of a valve. A dull emitter valve, such as the D.E.3 type, forms an interesting example of the skill of the operatives engaged in its construction and of the ingenuity of the various machines. The preliminary operations result in the production of what is known as a pinch or seal. Four copper wires are threaded through a short length of glass tubing, one end of which is expanded into a flange or bell mouth. The unflanged end of the tube is heated by blow lamps and squeezed flat, gripping the leading in wires and forming an air-tight seal.

The four supporting wires are bent to the correct shape according to the type of valve being constructed. In certain instances, such as in the case of a valve having a

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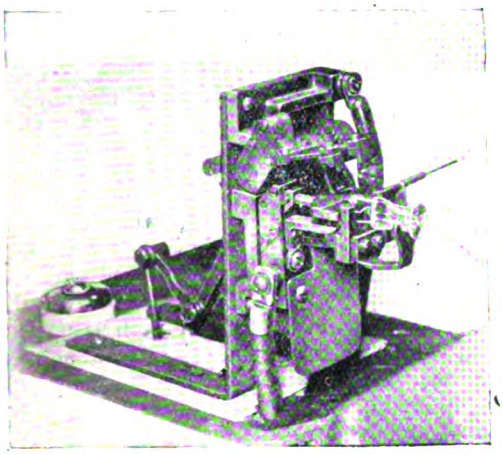
vertical filament, grid and plate and extension of the supporting system is added at this stage, consisting of top supports. These are joined into a rigid unit and at the same



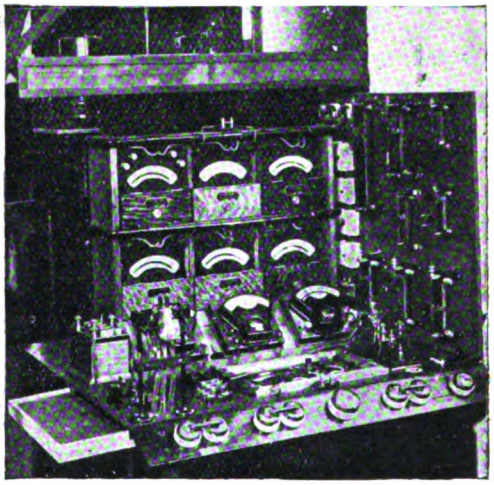
Spot-welding apparatus for assembly.

time insulated from each other by sealing them into a glass bead. This upper unit is attached to the lower portion by spot welding the upper filament support to one of the short filament stays.

In another portion of the works the grids, plates and filaments, are prepared ready for mounting upon their supports. The grids are made upon a machine on which the necessary number of turns correctly spaced are wound and spot welded at every turn to the supporting wire. The assembly of these components upon their respective supports calls for the greatest accuracy and delicacy of touch. An ingenious machine brings the parts in correct register with each other, and then swiftly and securely spot welds them into position.

The sealing-in process consists of inserting the seal with its filament plate and grid into a bulb, to the top end of which a short glass tube has been attached, through which the air will ultimately be exhausted. The seal and bulb revolve and are heated by gas flames until the two pieces of glass fuse together. The valve, when ready for exhausting, is attached to the air pump by the exhaust tube previously attached to the bulb. The high degree of vacuum necessary is obtained by raising the metal parts of the valve and the inner surface of the bulb to an extremely high temperature, a short length of magnesium wire, which is affixed to the plate, assisting this process.

Several methods of heating the plate and flashing the magnesium are adopted. That used for D.E.3 valves is known as eddy current heating. A coil of copper wire through which a high tension current of very high frequency can be made to flow is slipped over the bulb of the valve. The closing of the pump cage doors automatically switches on the high frequency currents, and in a few seconds the eddy currents induced in the plate have raised the metal to a sufficiently high temperature to flash the magnesium.



A typical test table where the valves are checked for filament consumption and emission.

The elaborate arrangements for testing every valve made at the M.O. valve works are worthy of particular note, for it is only in this way that the company are able to produce valves, in bulk, of absolutely standardised performance. A specially trained testing staff is employed to examine the valves, which are tested for filament consumption, for emission at set conditions, and for impedance. Finally a micro-ammeter gives a reading of the maximum reverse grid current. Having successfully emerged from these tests the valves are passed to benches for capping, marking and packing.

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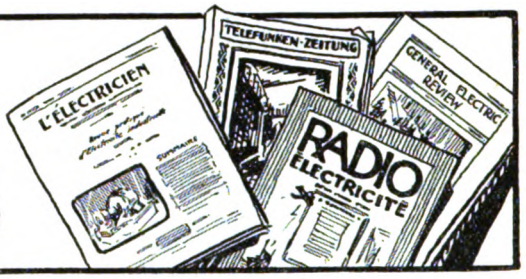
PATENTS AND ABSTRACTS



A Pile-Wound Variometer.

The object of the designer of this variometer* is to provide a piece of apparatus in which the distributed capacity is small, and which has novel features of construction. Instead of the usual form of single-layer winding, a banked or pile winding is employed, as may be seen from Fig. 1, where A is the rotor and B the stator of the variometer.

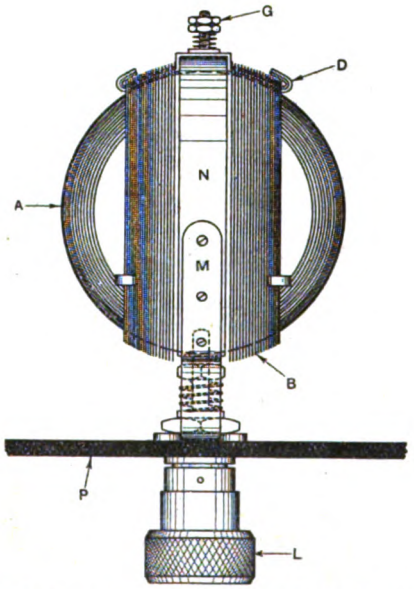


Fig. 1. A variometer having pile or banked windings.

Each coil consists of two separate parts, which are wound independently of each other, but on the same spherical-shaped former. When the winding has been completed, the turns of the coil are stuck together by the application of a solution of amyl acetate and celluloid. The two sections of coil forming the rotor are connected together by metal straps, which are covered on the side which comes in contact with the wires with an insulating material. A similar method of securing the coils of the stator is employed, but the strips (D, Fig. 1), are turned up to prevent the end turns slipping. The other features of construction will be apparent from the figure, where G is one of the spindles, L is the knob, P the panel, and M the securing bracket fastened to the insulating support N.

* British Patent No. 220,185, by C. J. Owen.

Reflex Receivers.

In most reflex receivers a number of valves are arranged to give high frequency amplification, the high frequency currents are rectified, and the rectified current fed back to the grid circuits of the high frequency valves through suitable coils or condensers in such a way that the first high frequency amplifying valve also operates as the first low frequency amplifying valve, and so on. This patent* describes a reflex receiver in which it is claimed that the amplification is obtained without loading any one valve substantially more than another.

The circuit appears as Fig. 2, where V_1, V_2 and V_3 are the amplifying valves, and V_4 the rectifying valve. Incoming signals are applied to the grid of V_1 at terminals A, B, and appear in the plate circuit, which includes the primary winding of the high frequency transformer T_1. Condenser C_1 provides a low impedance path between the end of the primary winding of this transformer and the filament.

* British Patent No. 204,301, by David Grimes.

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The secondary winding is connected between the grid and filament of valve V_2, condenser C_2 providing a low impedance path between the bottom of the grid coil and the filament. Valves V_2 and V_3 are connected in the same way as valve V_1, but valve V_4 has a grid condenser and leak connected in the grid circuit. The high frequency component of the currents which are rectified by valve V_4 has a low impedance path to the filament

The advantages of this method of connection are as follows :—The condenser C_3, which is designed to carry the high frequency currents flowing in the plate circuit of the detector, is shunted across the primary winding of the transformer T_2. High frequency currents may therefore pass between the primary and secondary windings of this transformer, and so reach the grid of valve V_3. If the output from the detector wer

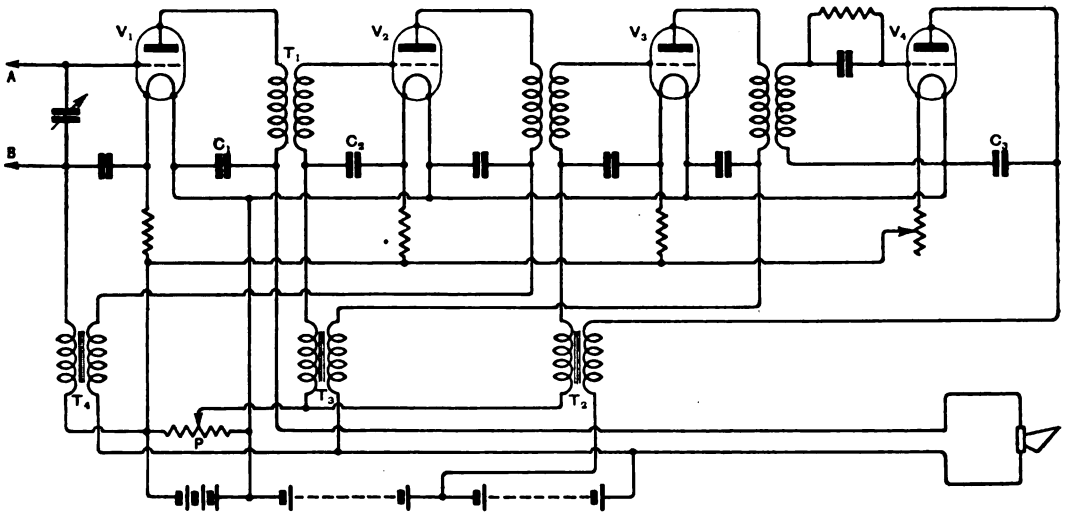

Fig. 2. Connections of a Reflex receiver.

through condenser C_3, but the low frequency currents pass through the primary winding of transformer T_2. The secondary winding of this transformer is connected in the grid circuit of valve V_3, one end being joined to the filament end of the high frequency transformer, and the other to the sliding contact of the potentiometer P. Hence the low frequency currents are amplified by valve V_3, and, appearing in the plate circuit are stepped up by a transformer, T_3, and applied to the grid of V_2. Valve V_2 amplifies the low frequency currents which are then applied to the grid of V_1 through the transformer T_4.

In the plate circuit of V_1 is the loudspeaker. It will thus be seen that the high frequency currents have received three stages of high frequency amplification, and that the low frequency currents have also been magnified three times.

fed back to the first valve, the high frequency leakage current would be amplified to such an extent that probably the receiver would be unstable.

Another advantage is obtained because low frequency signals which may appear on the grid of the first valve are not amplified to the same extent as they would be if the first valve were operating as the first stage of low frequency amplification, instead of as the last stage.

The intervalve high-frequency coupling transformers indicated in the figure are untuned. Hence they should consist of a number of turns of fine wire. If ordinary pin-type transformers are to be employed, it is advantageous to tune them by shunting the secondary windings with small variable condensers.

W. J.

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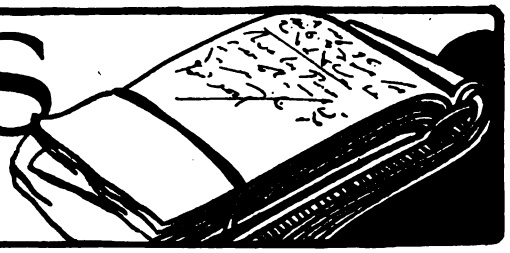
NOTES & CLUB NEWS



Australia's beam station is to be erected on Broadmeadows, in Victoria.

* * * *

Owing to interference with local signalling, the Liverpool and Leeds relay stations will probably be moved to new sites.

* * * *

Radio letters are now accepted at Marconi offices for Boston and Washington, at the rate of 3d. and 3½d. per word respectively.

* * * *

According to press reports, amateur wireless communication has been secured between New Zealand and California and Buenos Aires.

* * * *

Winnipeg (**CKY**), Moscow and Frankfurt am Main broadcasting stations now transmit regular features in Esperanto.

* * * *

STRENGTHENING THE AMATEUR POSITION.

As a direct result of the outspoken statement of Dr. Eccles, in his Presidential address before the Radio Society of Great Britain on the unfair conditions imposed by the Post Office on amateur transmission, Mr. John Scott-Taggart has placed the sum of £500 at the disposal of the Radio Society to assist in fighting a test case with the authorities, should the Society so decide.

This offer, in addition to that of the same amount by *The Wireless World and Radio Review*, furnishes an imposing sum, which should prove of very material assistance to the amateur in his fight for recognition.

2 KF REACHES BRAZILIAN COAST.

Communication with the Italian naval vessel "San Marco" (**1 HT**) near the Brazilian coast was obtained on Wednesday, September 24th, by Mr. J. A. Partridge (**2 KF**), at 2.30 a.m. G.M.T.

The operator of **1 HT** was the well-known Italian amateur, Signor Andriano Ducate (**ACD**), of Bologna. After exchanging greetings **1 HT** stated that **2 KF**'s signals, although rather weak and badly jammed, were remarkably steady and clear and far more easily readable than many American amateurs at half the distance.

The wavelength of the two stations was practically the same, both being below 100 metres. **2 KF**'s power was 100 watts, with an aerial current of 1 ampere. The signals from **1 HT** were very strong when a combination of detector and 1 L.F. was used.

Prior to Mr. Partridge's report we had been notified of the reception of **1 HT** by Mr. W. D. Keiller (**6 HR**), of Southgate, and by Mr. E. J. Martin, of Cobham, Surrey.

AMATEUR TRANSATLANTIC WORKING.

Transatlantic two-way communication has already commenced for the winter and DX reports have been forwarded to us by Mr. G. Marcuse (**2 NM**) and Mr. J. A. Partridge (**2 KF**).

On Sunday, September 21st, Mr. Marcuse worked successfully with **VDM**, the Canadian Government Exploration Steamer "Arctic" on its way to relieve the North-West Mounted Police Posts. This communication was effected with the aid of Canadian **1 AR**, Mr. Joe Fassett, of Dartmouth, N.S. The "Arctic" operated on 140 metres, using 190 cycle A.C., and about 2 kilowatts input.

At 2.50 a.m. on September 23rd, Mr. J. A. Partridge exchanged signals with American **1 AAC** of Framingham, Mass. **1 AAC** transmitted on 75 metres, **2 KF** replying on 95 metres.

BROADCASTING FOOTBALL.

First-class side line descriptions of all important football games during the coming season are promised by **WEAF**, the broadcasting station of the American Telephone and Telegraph Company in New York.

The games will be graphically described by Mr. Graham McNamee, **WEAF**'s principal announcer.

COLOGNE WIRELESS RESTRICTIONS.

A prosecution relating to the possession and operation of an unauthorised wireless receiving set took place at Cologne on Thursday, September 18th, when Herr Bodenstedt was fined 200 gold marks (£10 15s.) by a British Summary Court for contravening the wireless regulations imposed under the Peace Treaty.

From time to time the Rhineland Commission has reconsidered this restriction, which is strongly resented by the population in the occupied areas, but up till now no step has been taken to legalise broadcast reception.

WNP'S RETURN.

After 15 months in the Far North, Captain Macmillan and his party in the ship "Bowdoin" (**WNP**) have docked safely at Sydney, Nova Scotia. Coincident with the return of the expedition comes the news from Australia that **WNP** has broken all records for 200-metres long distance transmission.

Owing to limitations of space, the "Bowdoin's" transmitter, constructed by the Zenith Radio Corporation, of Chicago, was restricted to the low power of 100 watts. Notwithstanding the fact that the "Bowdoin" was frozen in during the winter within 11 degs. of the North Pole, communica-

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tion was maintained all over the U.S.A. and Canada. **WNP**'s operator, Mr. Donald Mix, was, however, unaware, on May 19th, that his signals were carrying to Australia. At 4.30 p.m. on that day, operator Cottrell, of Coogee, Australia, distinctly heard **WNP** working with **6 XAD**, located at Avalon on the Catalina Islands.

The distance covered by this transmission is over 9,060 miles. According to Cottrell's report, which has been closely investigated and confirmed, **WNP** was in daylight at the time of this long distance feat.

WHAT CLUB MEMBERSHIP MEANS.

At a time when no efforts are being spared to enrol new members in the radio societies throughout the country, an especially appropriate appeal was made from **2 LO** on September 25th, by Mr. F. H. Haynes, who is a member of the Council the Radio Society of Great Britain.

Mr. Haynes pointed out the advantages of club membership to all who take even a passing interest in their wireless sets. Even those to whom popular, semi-technical and technical lectures did not appeal could reap benefit from the expert advice and help which were at all times available to club members and such service alone was well worth the nominal subscription of half-a-guinea a year.

WIRELESS AT MANCHESTER UNIVERSITY.

From a glance at the Prospectus of the Faculty of Technology of the University of Manchester for the Session 1924-25, it is evident that wireless is not neglected in the Electrical Engineering Course. The University possesses a transmitting station of its own (**5 DQ**), and the course includes experimental work on the installation.

ROME BROADCASTING.

A series of concerts and talks is being transmitted regularly from the Rome Broadcasting station on a wavelength of 426 metres between about 8.30 and 9.30 (G.M.T.).

Many good reports of reception in Italy and neighbouring countries have been received by the station authorities and reports from British listeners are warmly welcomed. These may be forwarded c/o the Editor of this journal.

DX ON THE RIVER.

An original and highly successful "Field" day was spent by the members of the Société Française d'Etudes de T.S.F., on Sunday, September 14th, when a large party travelled by the launch "La Madelon" down the River Seine.

A four-wire cage aerial was erected on board, and with a powerful receiving set and four loud speakers kindly lent by the Brunet Company, excellent results were obtained. A transmitter was also fitted, furnished by Messrs. L'Electro-Materiel.

During the morning and afternoon two-way communication was maintained with 8 AE, owned by *La T.S.F. Moderne*, at Rueil, and an interesting log was compiled registering signal strength at different points on the river. Two-way working was also carried out with M. Hueber (8 DP) Versailles.

After luncheon, a speech of greeting by D Framchette, the President, was broadcast from the boat on 200 metres and picked up by listeners-in in the Paris district.

During the International Horse Race on September 1st at the Belmont Park Race Track, New York, a description of the event was broadcast from the course through the Radio Corporation station **WJZ**. *Our photo shows Capt. H. de A. Donisthorpe, and in front of him Major Andrew White at the microphone.*

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Club Activities.

Correspondence for Secretaries of Societies will be forwarded if addressed to the office of this Journal, c/o the Editor.

In spite of rainy weather, the first Field Day to be organised by the North Middlesex Wireless Club, held on Saturday, September 20th, was voted a distinct success. The headquarters of the Club were located at the "Cabin," Cuffley, and here, owing to the courtesy of Mrs. Martin, two permanent aerials were available and some valuable comparative tests were carried out.

Some excellent communication with mobile car sets was obtained and among the discoveries made was that earth mats provide useful grips when starting cars which have become embedded in mud!

* * * *

Reference has already been made to the forthcoming wireless exhibition in Manchester, the largest of its kind in the City, which is to be held from October 14th to 25th, in the Exhibition Hall, Liverpool Road. Details in connection with the Exhibition were discussed by the Manchester Radio Scientific Society on September 17th and various committees have been appointed.

* * * *

Chemical rectifiers were discussed by the Streatham Radio Society on September 10th, experiences being recounted by Messrs. S. C. Anstee, A. G. Wood and A. D. Gay. The Society warmly welcomes new members and a cordial invitation to the Wednesday meetings is extended to members of provincial and affiliated societies.

* * * *

The Borough of Tynemouth Radio and Scientific Society has already held its second meeting of the new session. Amateurs in the district are perturbed to learn that the Cullercoats Station (GCC) is shortly to begin a service of weather reports in morse, two or three times during the day.

Applications for membership of the Society are cordially invited.

* * * *

At the first meeting of the Autumn session of the Wimbledon Radio Society, held on September 19th, it was decided to hold another Field Day on October 9th. The Society has instituted a series of half-hour meetings weekly, to be devoted to morse practice.

The Hon. Secretary welcomes enquiries from prospective members.

* * * *

An attractive programme for the winter has been prepared by the Lewisham and Catford Radio Society, including a lecture on October 2nd, by Mr. Appleton, of Messrs. Radio Instruments, Ltd., who is dealing with the subject of "Transformers and Their Circuits."

* * * *

The Brockley and District Radio Association, which recently resumed its meetings, dealt with the intriguing subject of Crystal Amplification at the last meeting, the lecturer being Mr. B. Hughes, M.I.B.

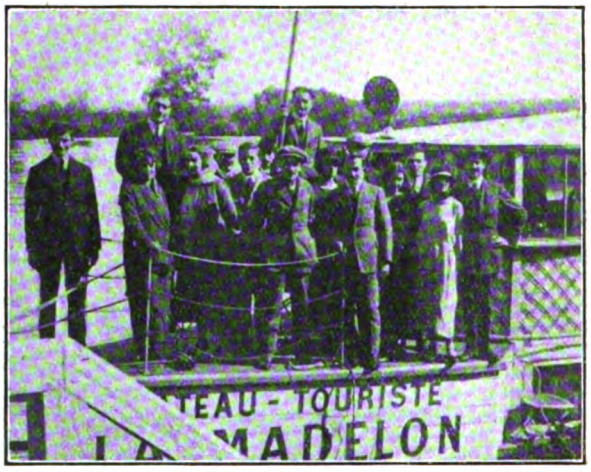
Intending members are invited to communicate with the Hon. Secretary.

* * * *

"Wireless in Schools" formed the subject of an enlightening lecture given by Mr. Usher before the Tottenham Wireless Society on September 17th. Having dealt with the subject in a general way, Mr. Usher gave an account of the formation and work of a School Radio Club with which he is connected. Mr. Loosemore then described the Morse Class and practical work, the latter being illustrated with excellently constructed crystal sets and tuners made by the scholars of the Raynham Road School, Edmonton.

* * * *

A new Society has been formed under the title of "The Dorking and District Radio Society," and will hold its first meeting on October 6th. Major G. C. Garrick has been elected President and the Hon. Secretary is Mr. A. J. Child, of High Street P.O., Dorking.



An enthusiastic group of members of the Société Française d'Etudes de T.S.F. photographed while on an experimental trip down the Seine.

FORTHCOMING EVENTS.

WEDNESDAY, OCTOBER 1st.

Radio Research Society, Peckham. At 44 Talfourd Road. Discussion: "Electrical Units."

North Middlesex Wireless Club. Lecture: "H.F. Amplification for the Baghdad Circuit." By Mr. W. Gartland.

Clapham Park Wireless and Scientific Society. At 7.45 p.m. At 67 Balham High Road. Business Meeting.

THURSDAY, OCTOBER 2nd.

West London Wireless and Experimental Association. At Belmont Road Schools, Chiswick. Lecture: "Telephone Receivers." By Mr. E. M. Doughty.

Bournemouth and District Radio and Electrical Society. At 7 p.m. At Canford Hall, St. Peter's Road. Second Annual General Meeting.

MONDAY, OCTOBER 6th.

Dorking and District Radio Society. First Meeting.

Barnet and District Radio Society. At 8.30 p.m. At the Barnet Wesleyan Lecture Hall. "A Day at **2 LO.**" By Mr. A. R. Burrows, Assistant Controller and Programme Director, B.B.C.

Dulwich and District Wireless and Experimental Association. At 8.30 p.m. Opening Meeting. Sale of Wireless Apparatus.

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THE WIRELESS EXHIBITION

A REVIEW OF EXHIBITS.

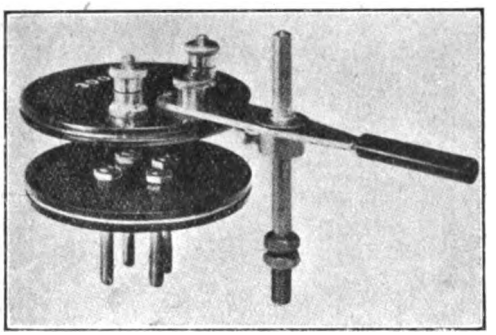
THE past twelve months have proved momentous ones for the wireless industry, and the rapid advances which have been made are strikingly portrayed at the Royal Albert Hall where the Wireless Exhibition organised by the National Association of Radio Manufacturers is now proceeding. The many improved components which the various manufacturers are exhibiting, show to a marked degree the trend of present-day design, which would appear to be towards simplification without in any way sacrificing efficiency. The Exhibition is open daily between the hours of 10.30 a.m. and 10 p.m., the price of admission being 1s. 6d. The closing date is Wednesday, October 8th. The following brief review of some of the exhibits will possibly serve as a guide to those whose time is too limited to allow of a close inspection of each stand.

An attractive cabinet receiver by the Edison-Swan Electric Co.

At the stand of Radiophones, Ltd., a selection of high class Listoleon apparatus is displayed. The Big Ben low frequency transformer is a product of this concern. The Listoleon modulator, another component which is available for inspection, is so designed that when used as an anode resistance, it will carry a large current and therefore a circuit in which it is employed will not vary in performance due to the heating of the resistance.

Square law condensers, high and low frequency transformers, rheostats, switches and variometers figure prominently among the other wireless apparatus on the stand occupied by the Edison-Swan Electric Co. A noticeable feature is the fine Chinese lacquer finish on some of the instruments. Sets and loud speakers decorated in the same style render the wireless receiver quite a part of the decoration scheme of any room.

The centre of interest at the Radiax stand is the new reactance unit which, mounted on the panel of a set, can be used in conjunction with any plug-in H.F. transformer. It consists of an interchangeable coil mounted on an arm which is arranged to swivel on a pillar, this being clamped



For use with plug-in H.F. transformers. The Radiax reactance unit.

to the panel. Three coils are available, providing a range of from 100 to 4,000 metres. The usual range of Radiax valve and receiving sets are shown in addition to tapped anode inductances and H.F. transformers.

A further example of neat workmanship by The Edison-Swan Electric Co.

Those who are acquainted with the headphones manufactured by The British L.M. Ericsson Manufacturing Co., Ltd., will notice that these instruments are now fitted with considerably

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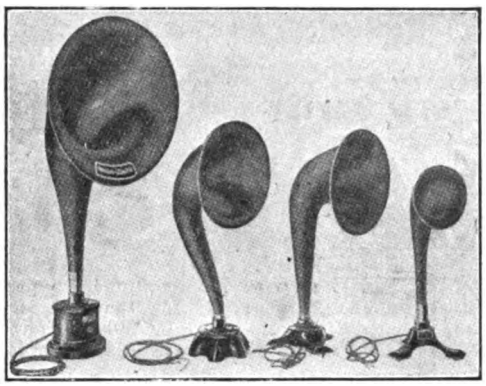
lighter headbands. Their general construction, however, remains the same. Ericsson components are attractively displayed, and in addition to current designs, several unique types such as a patent dual filament resistance, a useful safety wander plug and other interesting products are shown.

Of considerable interest, the exhibit of the Western Electric Co. comprises a wide range of receiving and amplifying apparatus, the Weconomy dull emitter and the Western Electric power valves. Two types of Wecovalve are being exhibited —the spring socket type and the four-pin variety. The range of loud speakers produced by this concern are prominently displayed. Several



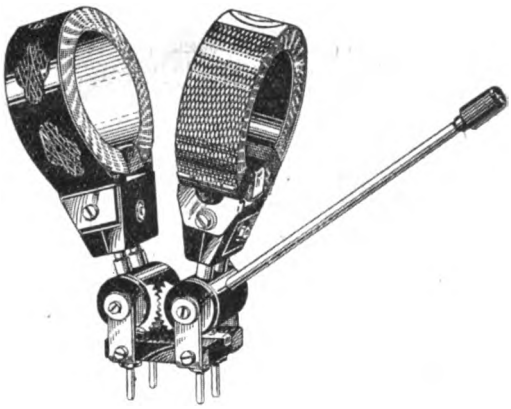
A feature on the stand of The Western Electric Co.

(Left) The four-pin type Wecovalve. (Right) A handsome loud speaker shown by A. J. Stevens & Co., Ltd.

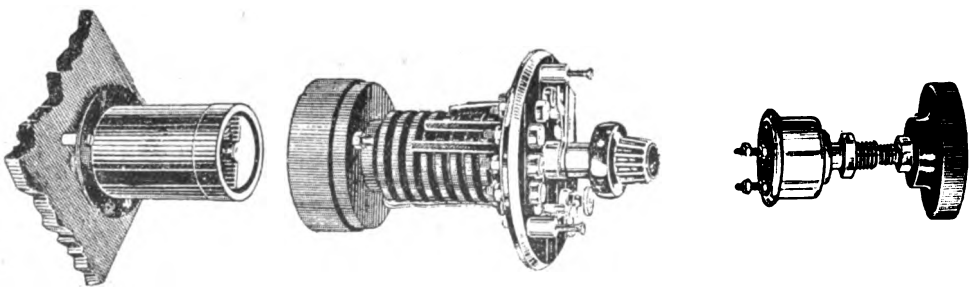
ingenious features are incorporated in these instruments, the delicately balanced armature system in one model deserving special attention.

A new Bijouphone model crystal set designed to receive on 1,600 metres is a speciality of Wates Bros. The most recent introduction of this concern is a tuned anode reactance for use in H.F. circuits. There are nine tappings, providing a range of 200 to 4,000 metres and a unique die-cast variable condenser is incorporated in the base for critical tuning. The improved Microstat filament resistances, fitted with terminals instead of soldering tags, are shown and also the Supra low frequency transformer, wound in insulated layers of six sections.

Examples of their new model receiving sets are prominent on the stand of A.J. Stevens & Co. (1914) Ltd. A number of the A.J.S. variable condensers form part of the exhibit. These are fitted with



The new geared coil holder for obtaining fine adjustments. (A. J. Stevens & Co., Ltd.)



Wates Bros. tuned anode reactance unit and improved type Microstat condenser in the base of the reactance unit .Note the die cast variable

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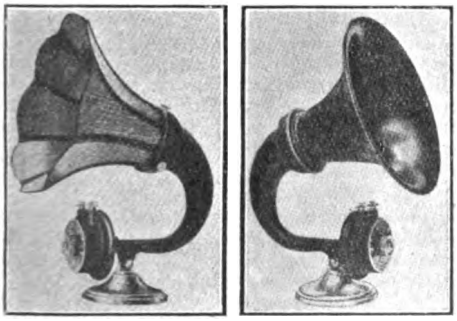
anti-capacity shields and the vanes are so shaped as to give a negligible minimum capacity. The A.J.S. loud speaker should be worthy of detailed inspection, as should also the new types of tubular steel telescopic aerial masts.

One of the range of Hart low tension accumulators.

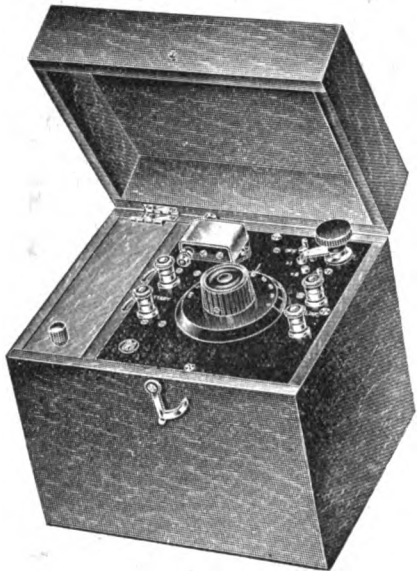
The various component parts of Hart batteries staged at the stand occupied by this concern should be of interest to many whose acquaintance with the construction of an accumulator is limited. It is possible to view Hart low tension batteries fitted in celluloid, glass and ebonite cases, the last named type being suitable for use in tropical countries where the high temperature conditions are unfavourable for celluloid types. The special splash-protected battery should interest owners of portable sets.



Two new Amplion models—the new Junior and the improved type of Dragon design.

It is not so very long ago that a loud speaker was considered rather a luxury, but now, due to the production of cheaper models, they are in universal use. Those in need of such an instrument will find types to suit every purse on the stand of Alfred Graham & Co. New introductions include the Dragonfly, the "New" Junior and the "New" Junior de luxe. These have been introduced to meet the demand for a loud speaker at a figure between that of the original Junior and the standard patterns. All these new models incorporate the floating diaphragm and the sound conduit is of the most successful non-resonating type.

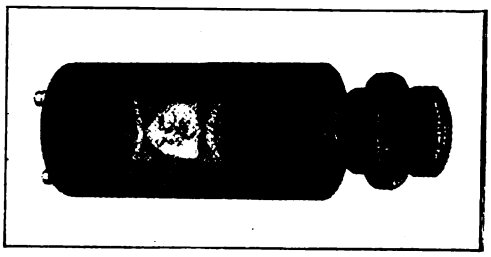
Much can be learnt regarding the construction of the new R.I. transformer by a careful study of the large section displayed by Radio Instruments, to operate over a wide range of wavelengths, which includes both the B.B.C. and the long Continental



Radio Instruments' speciality. A compact wavemeter.

Ltd. A large variety of completed sets and components are to be seen at this stand, where the new type of buzzer wavemeter may be closely inspected. Special attention is drawn to the extremely wide range of high frequency components manufactured by this concern. H.F. transformers are made in two wavelength ranges up to 4,000 and 30,000 metres.

Many new and novel components are conspicuous on the stand of Beard & Fitch, Ltd. This concern is responsible for the "Success" products. The new Success tuner has been specially designed



The anode capacity reactance which may be seen on the stand of Beard & Fitch, Ltd.

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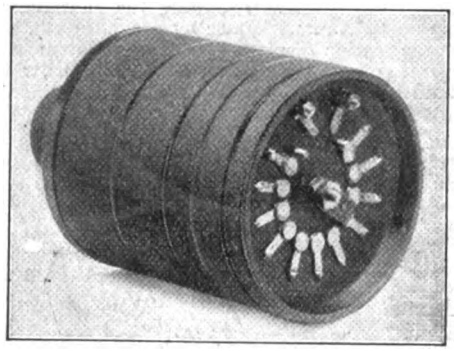
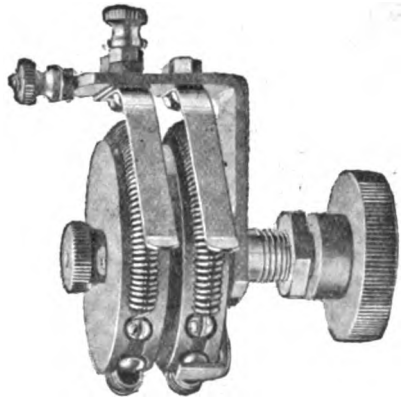
broadcasting waves. A companion to this unit is the anode capacity reactance by the employment of which any concert wavelength may be obtained without changing coils. Single hole fixing for both these units is a feature which should appeal to the amateur.



The new Success Tuner designed to operate over a wide range of wavelengths.

An easy and convenient method of assembling receivers is that adopted by the Radio Communication Co. in their Polar Blok system. It also has the advantage that further units can be added as desired. A full range of high-class components is shown by this concern amongst which may be mentioned the Polar triple condenser which consists of three similar air condensers mounted on one spindle. The micrometer condenser is one of their latest innovations and provides a means of obtaining highly delicate condenser tuning, whilst at the same time the instrument takes up the minimum of space on the panel.



An efficient rheostat which may be inspected at the stand of The Radio Communication Co.

New features in connection with valves are always of interest and this may account for the attraction which the Cossor stand appears to hold. The new Wuncell valves which are exhibited by this concern are manufactured in three types for use as H.F. amplifiers, detector and L.F. amplifiers and small power valves. Although intended to work from a two-volt accumulator, they may be used in conjunction with a 4 or 6-volt battery by virtue of the auxiliary resistance which is incorporated in the base. The new method of packing adopted ensures that the valve has not been used by the retailer for demonstration purposes.

A cheap wavemeter operating over a range of 300 to 1,800 metres is attracting much attention at the stand occupied by the National Wireless and Electric Co. Crystal and valve receiving sets are the other chief exhibits of this concern. A new and larger model of the Gnat crystal set is introduced, designed to receive stations operating on wavelengths up to 1,800 metres.

Several very novel features are embodied in the new Marconiphone V.1 receiver which is being shown to the public for the first time by the Marconiphone Co., Ltd. An exceptionally ingenious method of changing over for higher wavelengths is effected by changing one small block, which

The most recent Marconiphone model, the V.1 receiver.

contains both the aerial and reaction coils. The full range of the well-known Marconiphone components are shown, which includes variable condensers, crystal detectors and "Ideal" transformers in their three ratios.

Amongst the range of valves shown by The M. O. Valve Co., Ltd., are to be noticed a number of interesting new types. Among these may be mentioned a series, denoted types D.E. 4, D.E. 5, and D.E. 6, which are specially designed low frequency amplifying valves. A further valve of interest is known as type D.E. 5B, which has been designed as a L.F. valve for use in resistance capacity coupled amplifiers. Four electrode and transmitting valves can be inspected in addition to a H.T. rectifying valve.

A novel component which combines a knife switch, lightning arrester and lead-in tube, is to be seen on the stand of J. J. Eastick & Co. Further specialities staged by this company comprise switches, coil holders and variometers, a further exhibit of interest being the H.T. battery boxes.

An extremely fine display of ebonite is arranged on the stand occupied by the British Ebonite Co., Ltd. The highly polished sheets which will be noticed are entirely free from leakage, as the polish is obtained by hand, the matted sheets being also finished by this method. The new pattern dials and knobs which are exhibited call for special attention.

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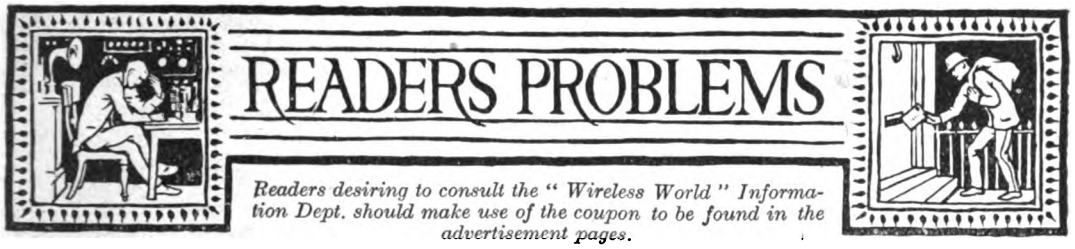
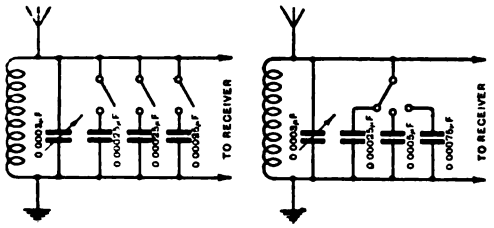


Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

REDUCING THE ZERO CAPACITY OF VARIABLE CONDENSERS.

A GOOD variable condenser should have a high ratio of maximum to minimum capacity. When the zero capacity is high, it may not be possible to obtain a sufficiently low ratio of capacity to inductance on short wavelengths, and in all cases the lower limit of the wavelength range available with a given value of inductance will be curtailed.

In a receiver designed for general reception it is an advantage to use tuning condensers with capacities as high as 0·001 μF when receiving signals on wavelengths above 10,000 metres. On the other hand, the zero capacity of a 0·001 μF variable condenser is likely to be troublesome on wavelengths below about 300 metres, and the high rate of change of capacity with scale reading makes tuning rather critical on short wavelengths.



Connections of compound tuning condensers.

These difficulties may be overcome by building up the maximum capacity with a series of small fixed condensers and a single variable condenser Thus, three fixed condensers, each of 0·00025 μF, used in conjunction with a variable condenser of 0·0003 μF maximum capacity could be used as a substitute for a 0·001 μF variable condenser. Each fixed condenser would be controlled by a separate switch suitably designed to have a low capacity when in the "off" position. Alternatively, a series of three condensers, having capacities of 0·00025, 0·0005 and 0·00075 μF respectively could be used in conjunction with a three-way radial type switch. It is imperative that the fixed condensers should be of very high quality, in order that the beneficial results of the low zero capacity may not be offset by the introduction of dielectric losses. The method of mounting the fixed condensers should be carefully studied from the point of view of reducing their capacity to other apparatus in the receiver. In this connection it should also be noted that the sides of the condensers which are not broken by switches are connected to earth; *i.e.*, a point of fixed potential. The variable condenser should have a maximum capacity slightly larger than the steps between the fixed condensers, and it should be borne in mind that a condenser of the square law type will be likely to have a lower zero capacity than one in which the moving vanes are semi-circular.

FREQUENCY OF TUNING FORKS

THERE seems to be some uncertainty among writers of text books on wireless telephony regarding the frequency of the note "middle C" in the musical scale. In some books the frequency is given as 256, and in others as 512, or twice the normal value. The discrepancy arises, no doubt, on account of the fact that some tuning forks are marked in "vibrations from the mean position" per second. The frequency of "middle C" is 256 complete cycles per second: thus the middle C fork would be marked 512 according to this system. A complete cycle is from the mean position to a maximum in one direction, then back to a maximum in the opposite direction, and finally back to the mean position, so that a complete cycle is equivalent to two "vibrations" of the fork. This difference in the method of expressing frequency is a frequent cause of trouble, and should not be overlooked in considering the applications of acoustics to wireless telephony.

FIXED FILAMENT RESISTANCES.

FROM the point of view of economy in apparatus and simplicity of operation, it is often an advantage to use fixed instead of variable filament resistances. The efficiency of the receiver will not be affected unless the filament current falls below the value necessary to give a sufficient emission of electrons for the particular value of H.T. voltage in use. For any given H.T. voltage there is a critical filament temperature, below which the valve will not function satisfactorily. On the other hand, an increase in the filament temperature above this value will bring about very little change in the signal strength. The fixed resistance should therefore be chosen so that the maximum filament current specified by the makers is flowing through the valve when the battery is fully charged. As the voltage of the battery decreases during discharge, the filament current will

D

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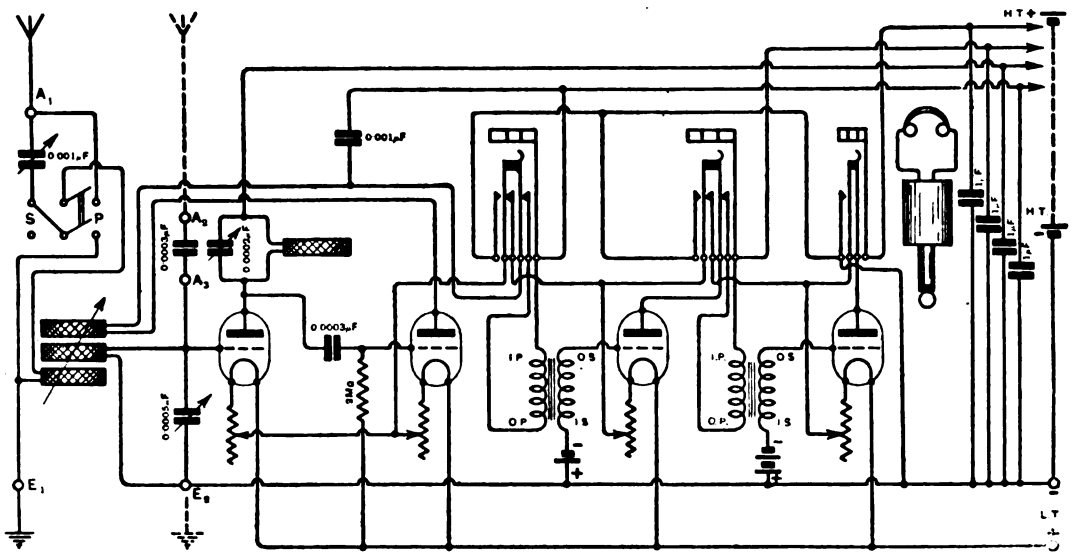
also decrease until the critical value is reached, when the set will first give distortion, and then cease to operate. This condition may be reached before the battery is fully discharged, and a fresh charge will have to be given before the set can be put in operation again. With a variable filament resistance one can keep the filament current constant until the battery is discharged to its minimum voltage, which is, in the case of lead accumulator cells, about 1·8 volts per cell.

A General Purpose Four-Valve Receiver.

THE accompanying diagram shows the connections of a four-valve receiver suitable for general reception. An inductively coupled aerial tuning circuit may be used, or the aerial may be directly coupled to the first valve by the method suggested in this section of the journal for September 3rd, 1924.



A general purpose four-valve receiver.

Tuned anode coupling will be found quite satisfactory, and is recommended because no additional components, such as H.F. transformers, are necessary if a complete set of plug-in coils is already available for the aerial tuning circuit.

The number of L.F. amplifying valves in circuit is controlled by means of a telephone plug and suitable jacks. The filament connections have been arranged so that the filament current to all the valves is switched off when the telephone plug is withdrawn from the receiver.

Adjustment of a Local Oscillator.

IN adjusting a supersonic heterodyne receiver, any type of measuring instrument which will aid the operator in observing the effects of his adjustments will prove invaluable. A correspondent has asked us to suggest a method of indicating when the separate heterodyne is in a state of oscillation.

The simplest method, of course, would be to connect a milliammeter in the plate circuit of the oscillating valve. The commencement of oscillations will be indicated by an increase in the current indicated by this meter. The current will return to the lower value when oscillations cease.

How to Obtain Smooth Reaction Coupling.

IN valve receivers employing reaction it very often happens that the adjustment of the reaction coupling is made very difficult by reason of the fact that oscillations start suddenly and do not stop again until the reaction coupling has been considerably reduced. When the receiver is properly designed and adjusted, it should be possible to control the reaction so that oscillations start smoothly and cease with the same degree of coupling that was required to start them. To obtain this condition, the value of the grid leak should be very carefully adjusted, and the size of reaction coil should be kept as small as possible. The adjustment of the L.T. and H.T. voltages also exercises a considerable influence over the reaction conditions. The by-pass condenser across the telephones or intervalve transformer connected in series with the reaction coil should never be omitted.

Readers who are interested in the problem of obtaining smooth reaction adjustment will find much to interest them in the article entitled "The Importance of the Grid Leak," by C. Handford, in the issue of this journal for July 30th 1924.

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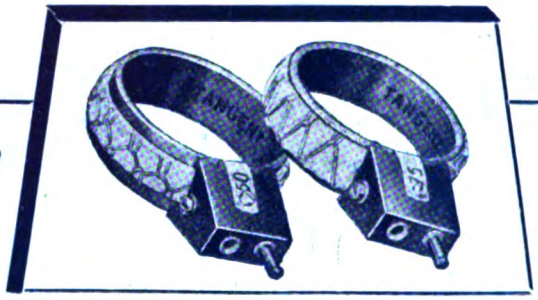

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

THE HIGH POWER STATION.

THE Post Office sanction for the erection of a permanent high power station by the British Broadcasting Company has now been given and an announcement has been made that the station will probably be in operation within the next six months. Readers will remember the concern which we expressed at a time when it was rumoured that the high power station might be located near in to London and it is therefore with considerable satisfaction that we learn that the station will be erected somewhere in a line between the Severn and the Wash. In an interview, Mr. J. C. W. Reith, Managing Director of the British Broadcasting Company, stated that the exact location would very probably be in the neighbourhood of Northampton.

The station will be licensed up to 25 kW. and will be operated on a long wavelength of the order of 1,600 metres as in the case of the present experimental station at Chelmsford. The new location will make it possible for the station to serve a very much greater area of the country than is possible from Chelmsford as the location will be more central, whereas in its present position nearly 50 per cent. of the energy must be lost in radiation oversea.

THE EMBLEM OF THE AMATEUR.

IT has often been stated that British amateurs are not knit together in a bond of union to anything like the extent of the amateurs in the United States who are members of the American Radio Relay League. A much closer co-operation might be achieved in this country and the position of the amateur strengthened to a very considerable extent if a closer understanding existed between individual amateurs and also between different societies and organisations.

The Radio Society of Great Britain, as announced by Dr. Eccles in his autumn Presidential address, has taken a step which it is hoped will assist in bringing amateurs together in this way. The decision has been made to issue a badge to be worn by members of the Society and members of Affiliated Societies. It will take the form of a design in coloured enamels of a size approximating to a sixpence and may be worn in the buttonhole. The design consists of the Union Jack surrounded by a frame aerial with the head of Mercury as a crest, whilst on either side of the head is a scroll to contain a motto. The name " Radio Society of Great Britain " appears across the Union Jack and round the lower half of the frame aerial. Those who are members of an Affiliated Society and not of the parent body will wear the badge without the head of Mercury and in place of the motto, the name of the Affiliated Society will be engraved. We believe that this badge will serve as a means of introduction amongst amateurs all over the country and that in a very short while it will become recognised wherever wireless amateurs are located in every part of the world.

IN DEFENCE OF THE AMATEUR.

THOSE who were not present to hear the Presidential address to the Radio Society of Great Britain by Dr. Eccles will by now have had the opportunity of reading it in print in *The Wireless World and Radio Review*, and they will also be aware that a sum of money amounting to £1,000 has been placed at the disposal of the Society by *The Wireless World and Radio Review* and *Wireless Weekly* in equal proportions to assist the Radio Society financially should the necessity arise for a test case to be fought

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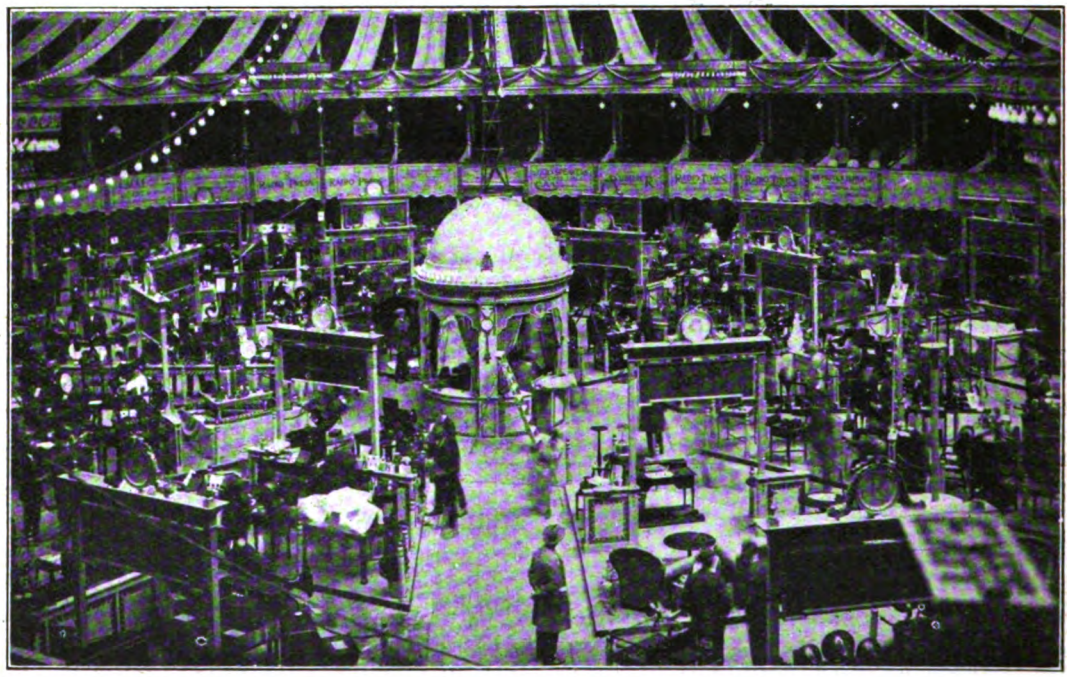
with the Post Office in support of the rights of the amateur. It is, of course, not possible to say much more on this subject until a further announcement has been made by the Radio Society as to what action they propose to take. It is, however, understood that a Committee is being appointed by the Council of the Radio Society to deal with the question and advise the Council as to the procedure which should be adopted. Our warmest support will be given to any action which the Radio Society may decide to take because we feel very strongly that in cases too numerous to mention the Post Office has dealt unreasonably with applications for experimental facilities which have been made by amateurs and we consider that the sooner matters of this kind are set right the better it will be for everyone concerned. Not only the amateur, but the country as a whole, must benefit by the results which accrue from the experimental work of scientifically inclined individuals or groups of individuals carrying on one particular investigation. We believe too, that a clearing of the air on the question of licences will be welcomed by the Post Office officials themselves who have the difficult task imposed on them at present of superintending the carrying out of regulations the legality of which they must feel, in their private opinions, is decidedly questionable.

THE WIRELESS EXHIBITION.

THE trend of development as illustrated in the Wireless Exhibition at the Albert Hall, certainly appears to us to indicate a marked tendency towards simplicity combined with compactness in broadcast receivers.



A general view of the central stands at the Exhibition at the Albert Hall.

Wireless, in so far as the manufacturer of broadcast receivers is concerned, has got beyond the experimental stage, if one may so describe some of the earlier efforts at the production of receivers.

The apparatus typified in the new models on view at the Albert Hall seems to indicate that manufacturers have achieved standardisation and we doubt if there will be any radical departure from the design of the present receivers by the best known manufacturers for some time to come. THE EDITOR.

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SHORT WAVE COMPONENTS

THE CONSTRUCTION OF PARTS USED FOR BUILDING A SHORT WAVE SET

THE first two-way transatlantic working with low power was carried out on a wavelength of about 100 metres. The exploitation of short wave working has revealed some remarkable results, and many experimenters have communicated over thousands of miles, using input powers which until recently would have been considered inadequate for bridging less than one-hundredth of the distance. Short wave working is rapidly opening up an entirely new field of development which is not only revealing the suitability of short wavelengths for bridging great distances, but is bringing about a concentration of effort to improve the design of receiving apparatus.

By F. H. HAYNES.

THE design of receiving circuits and tuning equipment has been developed essentially for use on wavelengths exceeding 300 metres. The attention which is now being devoted to reception on wavelengths of 200 metres and below not only calls for a review of the suitability of the usual form of instrument construction for short wave work, but is rapidly creating a need for specially designed apparatus.

The expressing of tuning adjustment by wavelength rather than by frequency obscures the vastly different conditions existing in circuits when working on 150 metres as compared with 300 metres. At 150 metres the oscillation frequency is just twice what it is at 300 metres and at 100 metres it is trebled, for the product of wavelength and frequency equals a constant. Now the losses in a circuit increase with the frequency, and thus the design of those parts in the component apparatus which give rise to loss must be carefully examined if efficiency is to be maintained.

SHORT WAVE INDUCTANCES.

The first aim in tuning coil design must be to produce minimum capacity for a given inductance. As air has a lower dielectric constant than solid insulating materials it is necessary for the turns composing the coil to be air spaced. The shape of the inductance must also be considered for a short coil consisting of several layers will require considerably fewer turns to produce a given inductance value than will be needed if the wire is formed up as a long single layer solenoid, and as a result will possess lower self-capacity.

Air is really the only permissible dielectric material, for solid dielectrics all introduce greater losses, which increase with the oscillation frequency. Thus the insulating pieces used to give rigid support to the coil should touch the turns at as few points as possible. The separating material employed for the construction of the supports must moreover possess low dielectric loss and good insulation. Comparing ebonite and oak in this respect, the dielectric losses in the

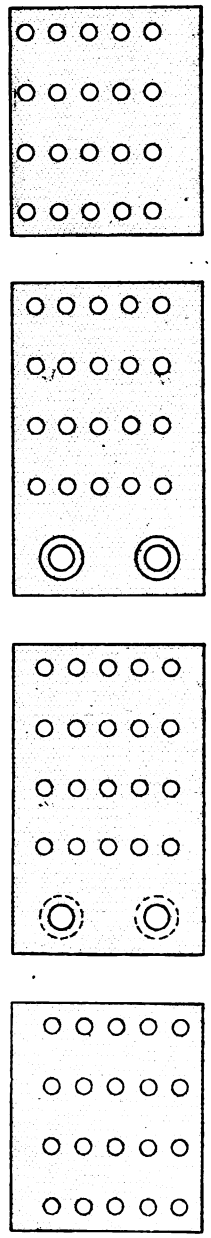

Fig. 1.

Ebonite mounting pieces for the low loss coils.

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former are greater than those when the latter is used, though oak, of course, does not come up to ebonite as regards insulation. Thus when the energy is small, ebonite will be more suitable, particularly as the low insulation set up by the oak in contact with the turns will produce a noticeable degree

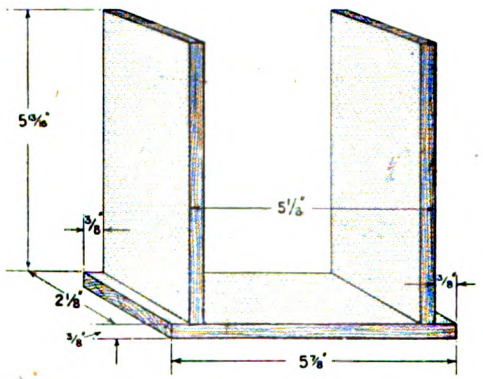

Fig. 2. Wooden frame to carry a pair of series connected coils.

of damping, evidenced by flatness of tuning. It might be mentioned, however, that when the energy is considerable, as in the case of the supports used to carry a transmitting inductance, that oak is preferable providing the insulation from turn to turn is sufficient to withstand the potential. Practical considerations must to some extent modify these ideals for a good mechanical design is a first requirement.

Low loss coils designed by the writer have been described in detail in recent issues of this journal,* and essentially consist of shaping wire of substantial gauge into spiral form, and threading drilled strips of ebonite on to the turns. Some further constructional details are given here to facilitate the building of tuning coils to a given size.

Fig. 1 represents the four ebonite supports into which the turns are threaded. It will be noticed that although all the holes are equally spaced, that they are set out at varying distances from the edges. This is necessary in order that all edges may be in line when the supports are themselves carried by the spiral turns of wire. The drawing shows these parts exact to size, the two centre portions being extended for attaching to a pair of wooden feet. Countersunk holes are made in these pieces to take the screws, one piece being countersunk on the top and the other on the underside. After drilling, the faces and edges should be finished with a matt surface, using medium carborundum cloth. It is advisable to mark all four pieces as finished with dot or scratch marks on a corresponding corner so that they may be readily identified in the correct order for slipping over the turns of the wire.

The wire should be shaped up by winding tightly on cylindrical formers, each about ½ in. less than the required diameter. The actual diameter of the inside layer when set up is 2⅜ ins. The holes are 5/64 in. which gives easy clearance for the wire, which is No. 16 S.W.G., enamelled covered to prevent oxidisation. When embodying this type of coil in a tuner designed to cover a waveband of 80 to 200 metres (to be described later), it will be necessary to employ a pair which although connected in series and assembled side by side, cannot be built up as a single coil of twice the length a

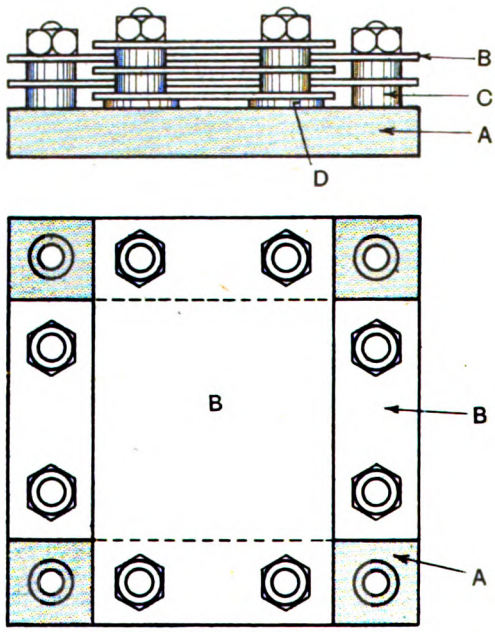

Fig. 3. Series aerial condenser, built up with zinc or aluminium plates and having air as a dielectric.

* *Wireless World*, February 13th, page 613; July 2nd, 1924, page 393.

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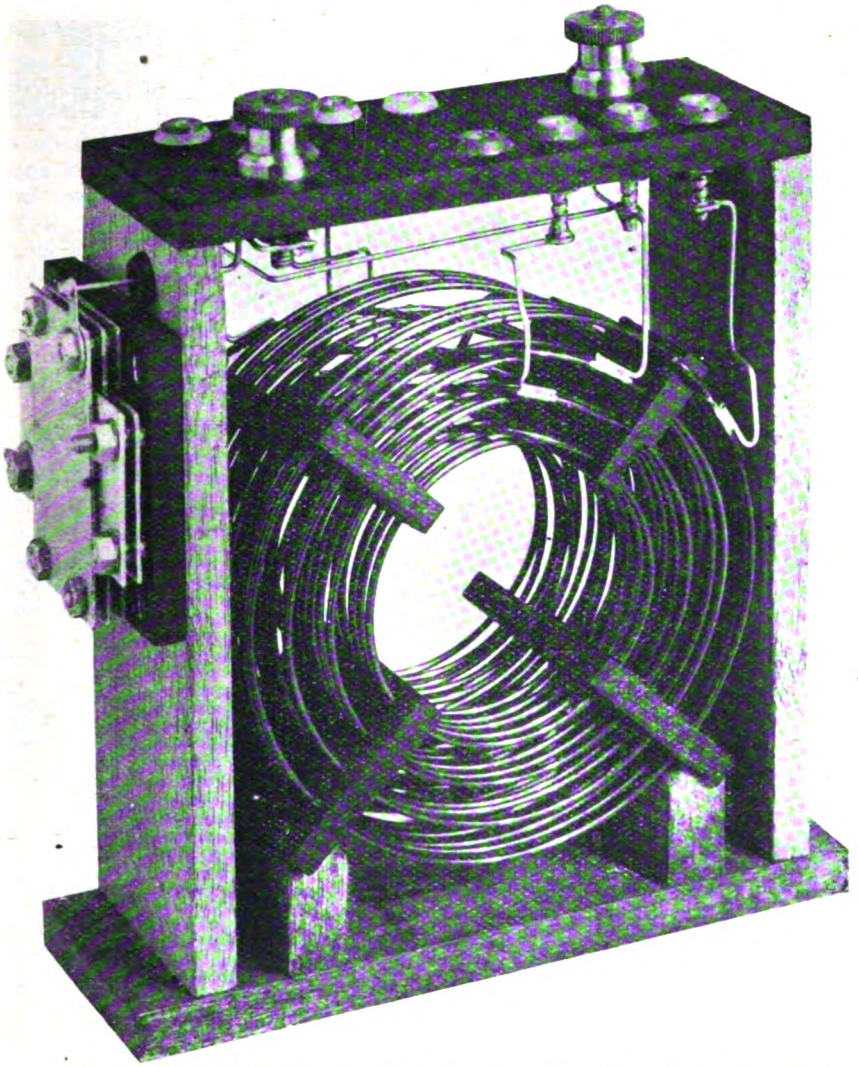
there would be set up too great a potential drop across the ends of each successive layer. In coiling the wire, which should be previously straightened by stretching, 14 turns will be needed of each of the four

of ebonite, followed by the other pieces in their correct order and the right way round. With only five turns to a layer and liberal clearance in the holes, no difficulty will be experienced in getting on the four layers.



Complete tuning unit comprising tapped aerial and secondary inductances and air dielectric series aerial condenser.

diameters so that when divided into two portions a sufficient length of wire will be left spare on the ends for connecting up. Be careful to wind all coils in the same direction.

The inside layer is best threaded on first, taking care to start with the correct piece

The author has built many of these coils and the threading on of the turns, as a result of practice, is only a matter of a few minutes. The beginning and finishing ends of each layer will pass up through the pieces shown at the top and bottom of Fig. 1. All four ends on one side of the coil should be ter-

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minated by bending back round the ebonite, well cleaned and soldered. The long projecting ends on the other side of the coil are then taken through between the layers and soldered to the terminations of the next successive layers so that all layers are in series.

Small wooden feet are made up, preferably in mahogany (obtainable from dealers in fretwork supplies), and set up so that the ebonite pieces are exactly at right angles to each other.

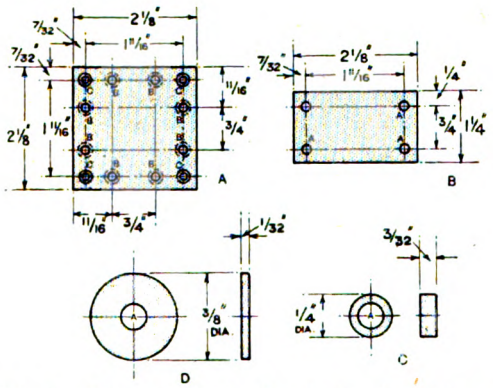


Fig. 4. Dimensional details of the air condenser. The spacing washers are also shown. A, 5/32", B, 5/32" and countersunk on underside, C, ⅛" and countersunk for No. 4 wood screws.

A simple mounting piece for a pair of coils is shown in Fig. 2, made from ⅜ in. planed mahogany. The sides are glued (Seccotined) and screwed in position. This woodwork should be carried out with accuracy so that it may suit the complete tuner to be described.

The woodwork supports a top ebonite piece drilled to carry aerial and earth terminals, and "Clix" sockets. The holes situated on the centre line are only fitted with a "Clix" insulating bush of the same colour as those in the corresponding row. Before fitting up, all surfaces should be neatly matted by rubbing with medium carborundum cloth.

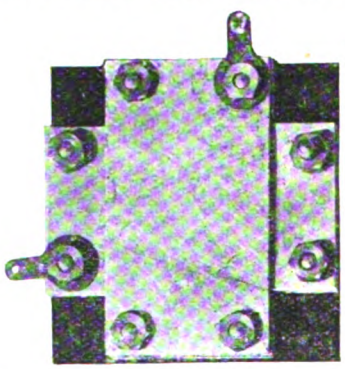
Both coils can now be mounted in the woodwork with outer faces scarcely projecting. While still accessible, connect the outside finishing end of one coil with the inside commencing end of the other, verifying that the direction of the complete winding is continuous.

Now screw the top ebonite terminal board in position and proceed to connect up. On one side will appear the three soldered connections where the layers are linked through. On the other side, one end and three bends are showing. On the former side where the end of the third layer (counting from the inside always) connects to the fourth, a wire is soldered and taken to one of the terminals which is to be "earth." Three short connections can now be made to join the beginning of the centre turn, and the other two junctions to three of the "Clix" sockets. Turning to the other side of the coil, the finishing end and the two cross-over connections next below are joined to the other three sockets. The object is to get three layers each tapped, then the earth connection and then five layers, being four on one coil and one on the other, tapped at the last three layers.

The insulating bushes without sockets are to pass out the flexible leads to the plugs.

Tuning Condenser.

To sharpen the tuning, shorten the wave-length, and to facilitate self-oscillating by reducing the capacity of the aerial circuit, a fixed capacity condenser is connected in series in the aerial lead. Again the aim should be to adopt air as a dielectric, and an easy form of construction is shown in Fig. 4.



The finished air condenser. It comprises five plates and has a capacity of not less than 0·000025 mfds.

The drawing shows all necessary details. The rectangular aluminium or zinc plates are cut to shape, squared up if necessary by filing, and assembled on 4 B.A. screws with the usual spacing washers. A condenser of this pattern is quite simple to make up, and has a capacity of not less than 0·000025 mfds.

In our next issue full details will appear for making up a short wave set (80-200 metres) suitable for the reception of American amateur and short wave broadcasting stations.

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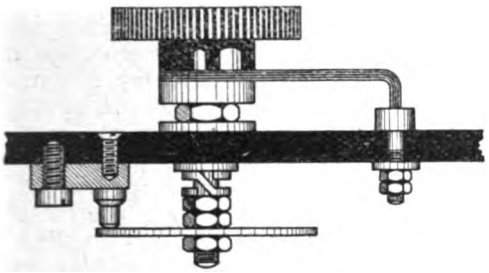
READERS' PRACTICAL IDEAS

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Making Good Spindle Contact.

MANY are the methods put forward for making reliable connection to a revolving spindle. Good contact is essential and in the case of switch spindles it is usually the practice to make use of a piece of flexible wire soldered to the end. Another



The spring peg out of a lamp socket can be used to make good contact with a revolving spindle.

method recently shown in these pages made use of a coiled bronze spring. It may be argued that this latter method possesses the disadvantage of introducing a few turns of inductance.

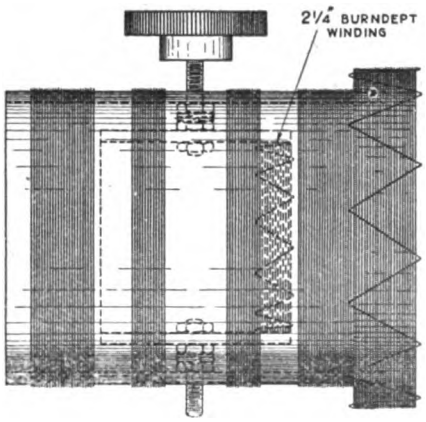
A good arrangement is shown in the accompanying sketch in which a brass plate is clamped on to the spindle with an additional nut. A reliable rubbing contact is made with this plate by means of one of the spring contacts removed from an electric lamp holder. This contact is fitted with two screws, one of which can be used for joining up to the circuit and the other for securing to the panel.

H. H.
F. T.

Loading up a Variometer.

WITH the introduction of broadcast transmissions on 1,600 metres many experimenters are desirous of converting variometer tuned sets to receive on this new wavelength. Although the method of loading shown here may not produce a variometer of wide tuning range it will give sufficient tuning provided the loading inductances are carefully adjusted as to size before they are attached. Lack of space in an instrument often prevents the insertion of loading coils and this method makes use of the variometer formers themselves, to give support to the loading coils. The loading coils are wound by the usual method on a former which carries a suitable number of pegs and the layers are spaced by means of a zig-zag winding of thin string or insulated wire.

The writer has fitted coils of this type to his loose coupler which is used to introduce



Loading a variometer.

reaction, the aerial circuit on the outside former being loaded by adding a winding of No. 26 S.W.G. wire and using about 220 ft., while the inner winding which is in the reaction circuit is made up of five

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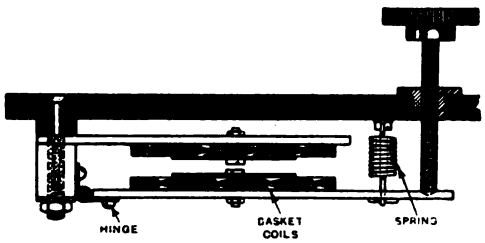
layers of No. 26 S.W.G. to a maximum diameter of 2¾ ins. and with a width across the face of about ½ in. This smaller coil just fits inside the reaction coil former, whilst the aerial loading coil slides over the existing aerial winding.

R. G. T.

Basket Coil Tuner.

WHEN basket coils are used for tuning it is not always a simple matter to devise a system of mounting that will provide for variable coupling, particularly as tuning is so critical on short wavelengths and the basket coils are usually not sufficiently rigid to allow of accurate adjustment.

In the accompanying diagram a method is shown of mounting the coils. It will be seen that the screw on the left-hand side of the diagram not only secures the fixed coil but also carries a wooden piece to which a hinge is fixed. The hinge carries a strip of wood or ebonite to which the moving coil is attached so that it can be propelled away from the fixed coil by means of the threaded screw shown on the right-hand side, whilst a spring keeps the hinged piece rigidly in position.



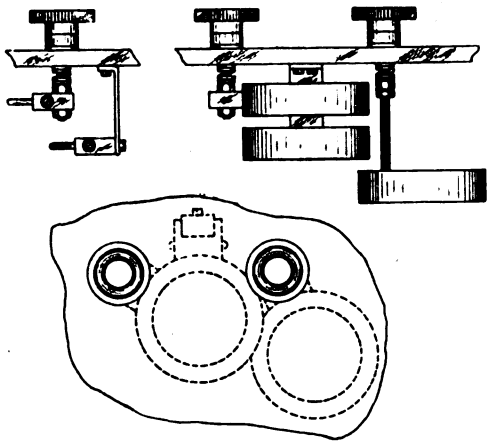
Simple coupling for basket coils.

W. A. E.

Under the Panel Three-Coil Holder.

THE amateur usually considers it within the scope of his ability to build his own three-coil holder and a design is shown here which is a departure from the usual method of construction.

It possesses the advantage that the tuning coils are fitted entirely beneath the panel and for a receiver operating over a limited wavelength range this arrangement will be found particularly useful. An interchangeable mounting is provided, of course, and where it is desired to frequently change coils, the holder must be mounted in the instrument to give the necessary access.



Three-coil holder constructed beneath the panel.

From the diagram it will be seen that the central coil which is stationary is carried on a brass bracket, whilst the two movable coils are secured to a threaded rod such as can usually be obtained from dealers in component materials. Other details can be seen in the drawings and it is not thought necessary to describe the construction at further length as the experimenter may make minor changes depending upon the parts he may have to hand.

A. R. T.

C.W. Buzzer.

While carrying out reception of spark, I.C.W. or telephony, it frequently happens that tuning has to be performed on a heterodyne, there being no buzzer wavemeter available.

The writer has included in the grid circuit of his wavemeter a grid leak shunted by a condenser which may be introduced at will by a small switch.

The apparatus is adjusted so that the grid leak is of rather a higher value than that generally used (about 5 to 6 megohms) and the valve is paralysed for considerable periods (1/200th of a second or so). The note heard in the receiver is a buzz, and has the advantage that it maintains a constant pitch under all conditions, unlike the buzzer usually fitted.

R. W. H.

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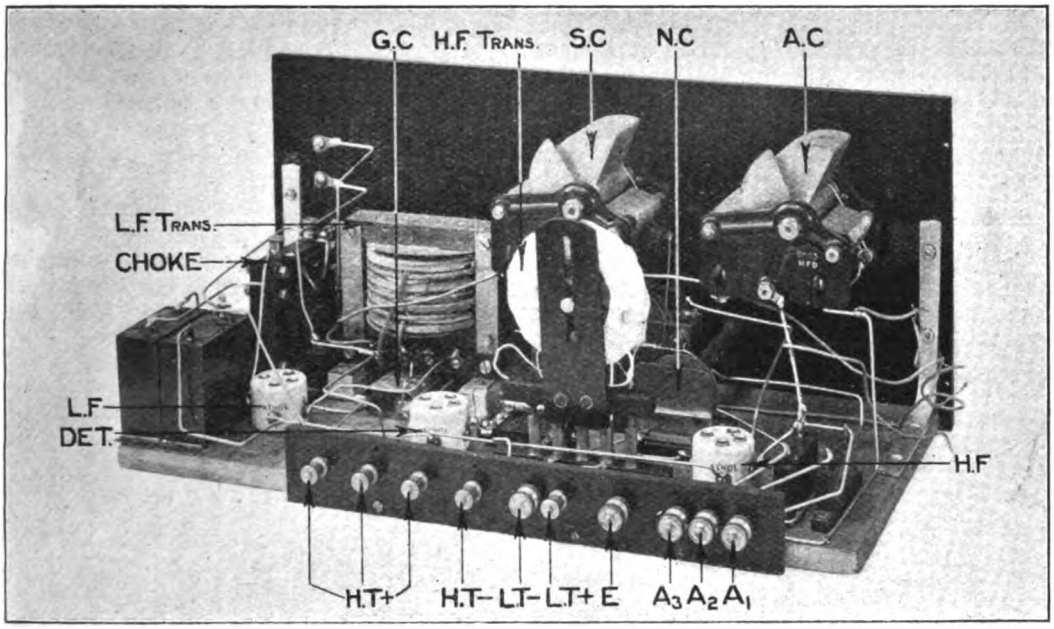

A back view of the completed receiver with cabinet removed.

THE SUPER-SENSITIVE RECEIVER.

By W. James.

(*Concluded from page 12 of previous issue.*)

The Detector Valve Circuit.

We have now to consider the detector valve circuit. The grid condenser and leak method of rectification is employed, the grid leak being connected across the condenser, and the return wire of the grid circuit being connected to the positive side of the filament. The grid condenser may have the usual value of 0·00025 μF, and the grid leak a value of about 2 megohms. Several grid leaks of different resistance values should be tried, the aim being to secure good signal strength, purity, and smooth reaction control.

The size of the reaction coil and type of intervalve transformer to be connected in the anode circuit of the detector valve is decided by the type of valve. I wish to emphasise the fact that for good quality speech amplification it is not correct to take any type of valve and use it with any type of transformer. It is sufficiently difficult to manufacture a transformer which will give good results with one type of valve. General purpose transformers (by which I mean those which are sold without any indication as to which type of valve they are designed to work with) should not be used unless it is found by experiment that they work well with the valve which is to be employed as the detector. The reason why many transformer-coupled speech amplifiers give poor results is because the valves and transformers have not been matched. This is hardly the fault of the reader—the manufacturer should design his transformers and specify the types of valve with which, under correct operating conditions, they will give good results.

In the receiver under discussion a D.E.5 valve is employed as the detector. This type of valve has a voltage amplification factor of

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about 7, and an impedance of 7,500 ohms, whereas an "R" type valve has an amplification factor of about 8, and an impedance of 40,000 ohms. Because of the low impedance of the valve, an intervalve transformer* having a turn ratio of six to one is employed. If the reader prefers to employ an "R" type valve, it would be better to employ a transformer having a turn ratio of two or three to one.

Those who use a low impedance valve as the detector will find that a smaller reaction coil than usual gives best results. The writer has found a No. 35 Igranic coil is suitable with this receiver, with an anode voltage of 35 volts.

THE NOTE MAGNIFIER.

The secondary winding of the intervalve transformer is connected between the grid and filament of the third valve. A small dry cell battery of 4½ volts is employed in the grid circuit to give the grid a suitable normal negative potential. This battery is essential if distortion from grid current is to be avoided. To compensate for the reduction in the effective anode voltage brought about by making the grid several volts negative, the voltage of the anode battery applied to the last valve should be increased. An anode voltage of 120 volts is suitable when a D.E.5 type of valve is employed. When an ordinary 2,000 ohm loud speaker is used, it is essential to employ a low impedance valve in the last stage if good quality is to be obtained; or if a general purpose valve is employed, a transformer should be used to efficiently couple the valve and loud speaker.

The normal anode current when a D.E.5 type valve is used in the last stage is fairly heavy (about 4 milliamperes). Hence a filter circuit is employed. The anode feed current is carried by a choke coil, and the speech currents flow in the circuit comprising a large condenser and the loud speaker shunted round the choke.

The choke should have a large inductance with low resistance. An inductance having a reactance of about three times the impedance of the valve at a frequency of 200 cycles is satisfactory, which indicates, in this case, an inductance of about 20 henries. The inductance of the primary winding of many intervalve transformers is between 10-12 henries. Therefore a suitable choke may be constructed by employing the core of a medium size intervalve transformer of liberal cross-section and a winding of 5,000 turns of No. 38 D.S.C.

CONSTRUCTION OF THE RECEIVER.

The receiver is shown in the accompanying illustration, from which it may be seen that

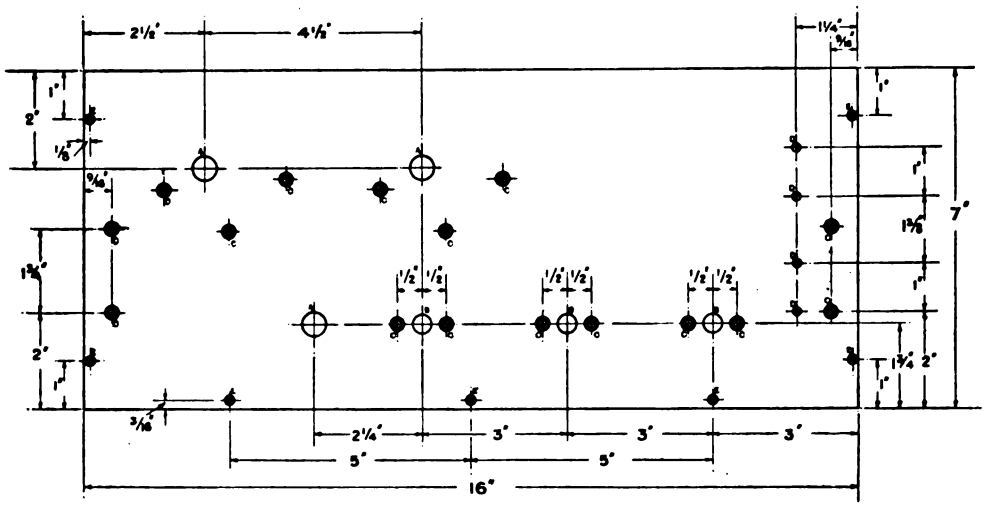

Fig. 4. Scale drawing, ½ exact size, of front panel giving drilling dimensions. A, drill ¼" dia.; B, ⅜" dia.; C, 5/32" hole and countersunk on top side for No. 4 B.A. screws; D, 5/32" dia.; E, ⅛" hole and countersunk on top side for No. 4 wood screws.

* The Ideal Transformer, by the Marconiphone Co.

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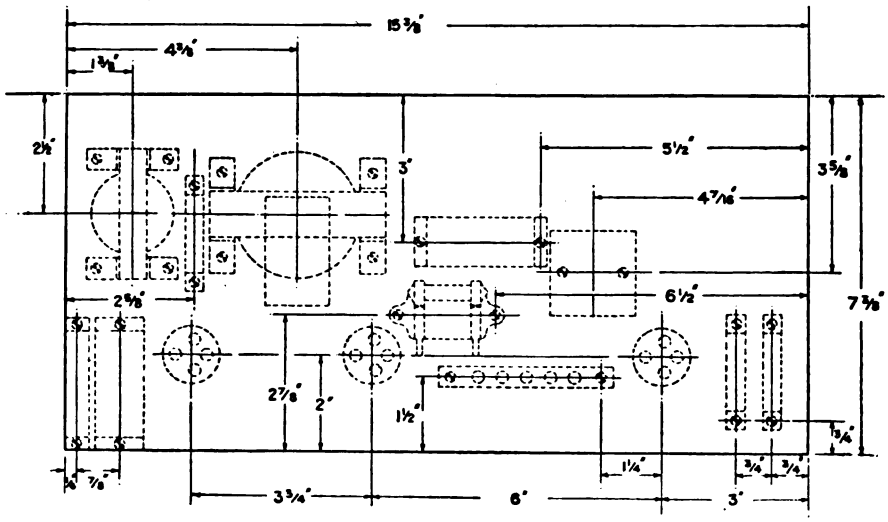

Fig. 5. Layout of components on baseboard. (¼ full size).

the ebonite panel carries the aerial tuning condenser and the high frequency transformer tuning condenser (A.C. and S.C.), the filament resistances (H.F., detector and L.F.), and terminals for telephones (T), and loud speaker (L.S.). The panel is of good quality ebonite, 16 by 7 by ¼ ins. To the panel is secured a wooden board 15⅜ by 7⅜ by ⅜ ins., by means of screws passing through the ebonite, and a pair of brass brackets. The valve holders, intervalve transformers, condensers, choke, neutralising condenser and terminal strip are secured to this board. Thus the receiver is totally enclosed; connections to the batteries, aerial and earth are made to terminals on the back of the set, and only the telephones or loud speaker is connected to terminals on the front of the receiver.

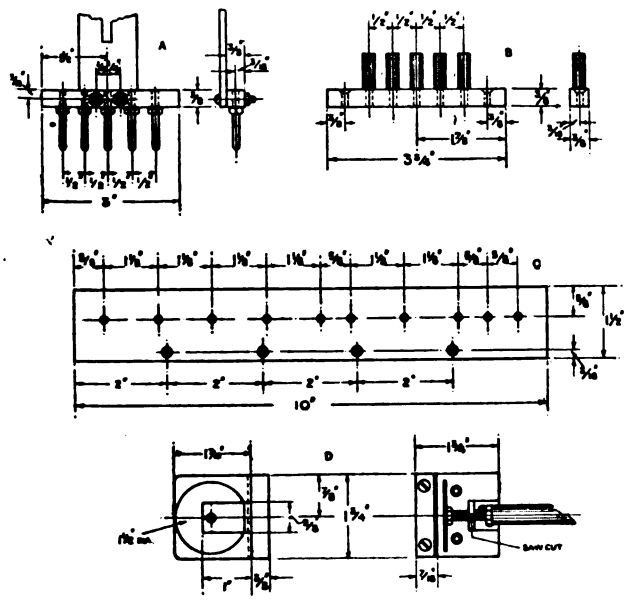

Fig. 6. Details and dimensions of parts. A and B, high frequency transformer plug and socket; C, the terminal strip, and D, the neutralising condenser.

It is convenient first to drill the panel and mount the components thereon; secondly, to mount the components which are fastened to the baseboard; thirdly, to construct and fix the neutralising condenser, high-frequency transformer and terminal strip; and fourthly, to wire the receiver. The two-coil holder (Webber) is fastened to the end of the case (Fig. 8).

Dealing with the panel, the sheet of ebonite (16 ins. by 7 ins. by ¼ in.) is marked out according to the scale drawing of Fig. 4. Sterling 0·0005 microfarad "square law" vernier tuning condensers and Igranic filament resistances are employed. These are secured to the panel as

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indicated in the figure, where the large holes marked A and B are $\frac{1}{2}$ in. and $\frac{3}{8}$ in. in diameter to clear the spindles of the condensers and filament resistances respectively. The fixing holes marked C are 5/32 in. diameter and countersunk for No. 4 B.A. screws. Of the remaining holes, those marked *E* in the lower edge of the panel are $\frac{1}{8}$ in. diameter, countersunk for No. 4 wood screws; these screws fasten the bottom of the panel to the edge of the baseboard. The holes marked *E* on the side edges of the panel are $\frac{1}{8}$ in. diameter, countersunk for No. 4 wood screws, which screw the panel to the case. Two 4 in. brackets are employed to hold the panel and baseboard at right angles; the holes for the fixing screws are marked *C*. Terminals for the telephones and loud speaker are mounted at the points marked *D*.

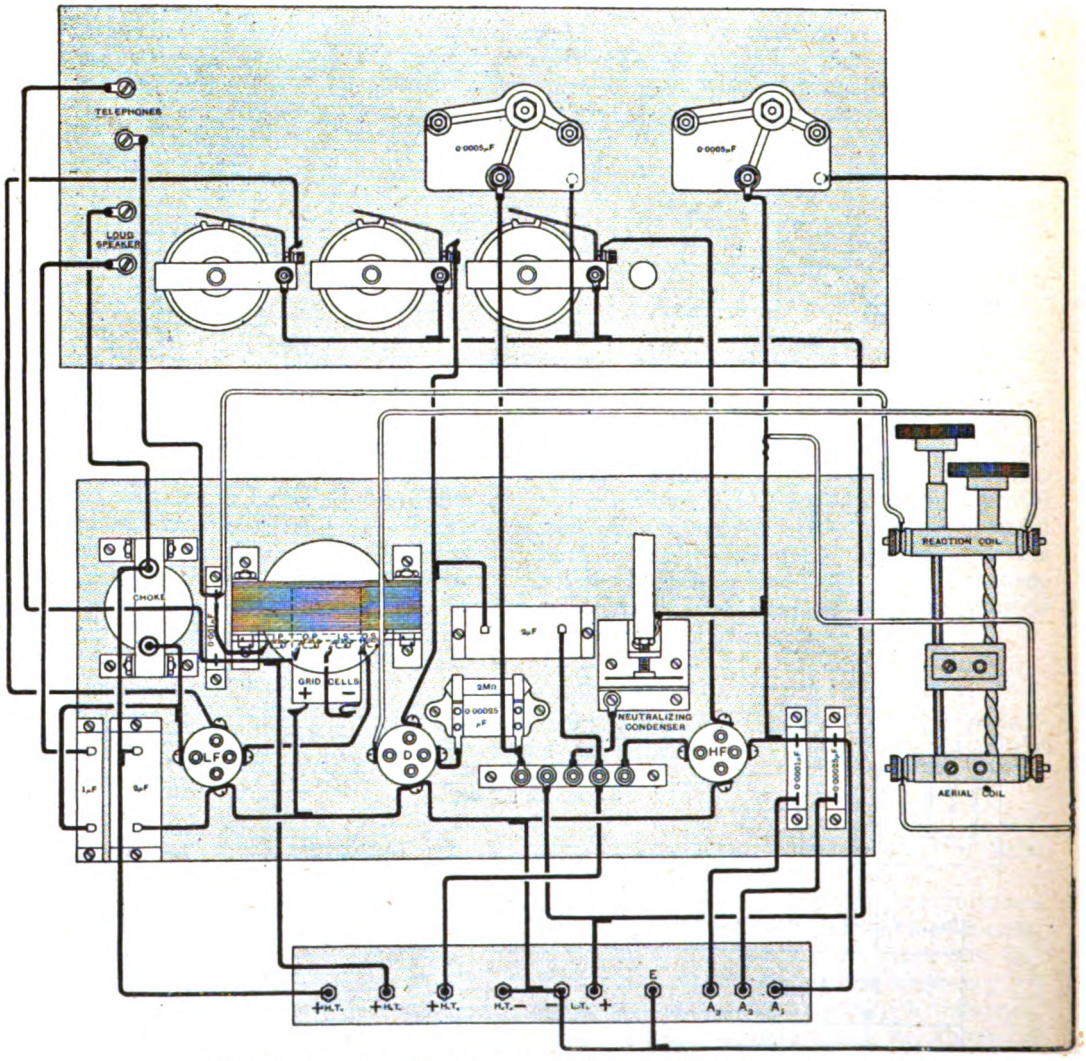

Fig. 7. Complete wiring diagram of the Super-Sensitive receiver.

The position of the components mounted on the baseboard is given in Fig. 5, and the parts may easily be identified from the layout of Fig. 7. It will be seen that fixed condensers of 0·0001, 0·00025 (2), 0·001, 0·5 and 2·0 (2) microfarads are required, with a 2 megohm grid leak, 3 valve holders,

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an intervalve transformer, and an iron-cored choke coil.

Details of the high frequency transformer, plug and socket, the terminal strip, and the neutralising condenser are given in Fig. 6.

The H.F. transformer socket consists of a piece of ebonite, 3¾ ins. by ⅜ in. by ⅜ in., to which are screwed five valve sockets; the plug of the transformer is a piece of ebonite 3 ins. by ⅜ in. by ⅜ in., carrying five valve legs, and a basket-coil holder. A number of plug-in units should be constructed to carry basket coils of different sizes if it is desired to tune over a wide range of wavelengths.

The neutralising condenser consists of a small piece of ebonite carrying a fixed plate and a movable plate. The ebonite is 1¾ ins. by 1¾ ins. by ¼ in., and the fixed plate is a piece of brass 1¾ ins. by 1 7/16 in., which has one side bent over in order that it may be screwed to the ebonite. As may be seen from the photographs of the receiver, the movable plate is carried by a brass bracket, and is turned by a length of ½ in. ebonite rod which extends through the panel. The bracket is 1 in. high by ⅝ in. wide, and is drilled and tapped 2 B.A. A brass disc 1½ ins. in diameter is soldered to the head of a 2 B.A. screw 1 in. long, which is threaded in the screw hole in the bracket. The other end of the screw is screwed in the end of the ebonite rod.

Having assembled the receiver, it may be wired, but before commencing the wiring it will be found convenient to remove the variable condensers in order that the wires may easily be secured to the filament resistances. If a fairly stiff wire such as No. 16 tinned copper is employed, there will be no need to use insulating sleeving. The wiring is clearly shown in Fig. 7. It will be observed that four flexible wires are employed to connect the reaction and aerial coils to the remainder of the receiver. These flexible wires are passed through holes in the side of the box.

Operating the Receiver.

To use the receiver, connect the aerial to one of the aerial terminals (preferably A1 to begin with), and also connect the usual batteries. For the broadcast band of wavelengths, a No. 50 aerial coil and a No. 35 reaction coil may be employed. The H.F. transformer which was described on pages 10 and 11 of the last issue should have a primary winding of 24 turns and a secondary winding of 66 turns of No. 24 D.C.C. Tune in a signal with the reaction coil at right angles to the aerial coil. When the H.F. transformer is exactly in tune with the aerial circuit, it will probably be found that oscillations generated by the receiver are passing to the aerial. The neutralising condenser should therefore be adjusted by turning the ebonite rod attached to the moving plate until the circuit is quite stable. If the H.F. valve is inserted in the holder with a piece of paper over one of the filament pins, it will be found possible to adjust the neutralising condenser so that although the aerial and H.F. transformer circuits are in tune, nothing is heard in the head receivers. The neutralising condenser may be left in this position for reception, although sometimes a further slight adjustment is required for best results.

If the telephones are connected to the upper terminals, the filament resistance of the last valve may be turned to the "off" position as this valve is not in circuit.

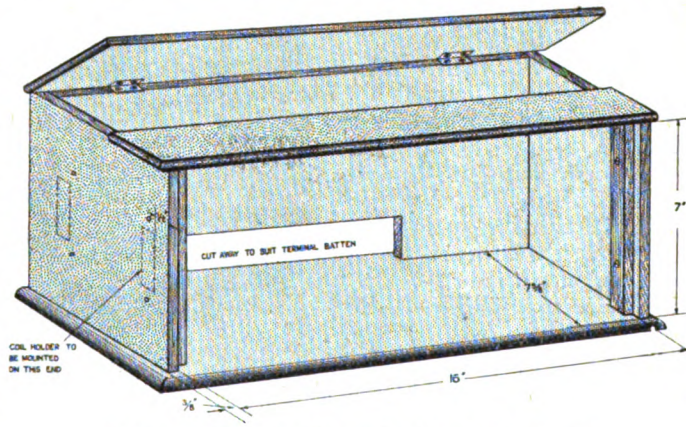

Fig. 8. Details for the construction of the cabinet.

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A VISIT TO THE

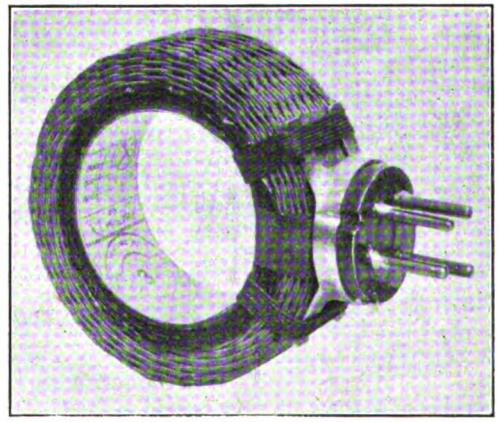
"IGRANIC" WORKS AT BEDFORD.

Discriminating amateurs, who rightly desire to obtain the utmost efficiency from their apparatus, are ever on the alert to discover the latest developments produced and would gladly welcome the opportunity of a visit to the hives of industry which are laid out specifically to cater for their requirements. We have arranged to visit the factories of the leading makers of radio components and will, from time to time, record in these pages reports of our visits and describe points of special interest for the benefit of our readers.

THE army of experimenters who build their own sets are compelled through lack of plant, to purchase at least some ready-made components such as valves, transformers, telephones and the like.

Recently we visited the works of the Igranic Electric Company at Bedford, where we were courteously received by the General Manager, Mr. A. H. Curtis, and one of his assistants, Mr. P. H. Pettyfer.

Having explained the reason of our visit, we were invited to roam through the works without let or hindrance and handle and examine the products of this well-known firm in the various stages of manufacture.



An Igranic honeycomb high frequency transformer.

The Igranic Works was in existence long before the arrival of the wireless boom, and their chief business was the manufacture of electric control devices of all descriptions—from the small switches of the tiniest motor to the huge and complex equipments for the control of dry docks, steel mills and mines, and the movement of the bascules of some of the largest bridges in the world.

It will be appreciated therefore that when this concern decided to install a radio department as an extension to its activities, this new venture was backed by a wealth of useful knowledge and sound experience.

Possibly very few persons have the least conception that the word "Igranic," which has established itself as a hall-mark in the world of radio, means something definite. It is a coined word introducing "*I*ron" to denote strength, "*gran*ite" to signify endurance, and "electr*ic*ity" to explain the great force of nature which its products harness.

The works, which by the way are now being enlarged so as to almost double the floor capacity, not only consist of such departments as the machine shop, winding room, assembly room, progress and despatch stores, and the usual divisions of organisation which are necessary to well-directed output; but, in order to ensure a high standard of excellence and uniformity for its products, research work and daily tests of apparatus drawn at random from the factory are carried out in the light, airy and well-appointed laboratory, a corner of which is here illustrated.

Having been privileged to enter this section also, we did not fail to observe that no expense has been spared in its equipment. Such standard instruments as National Physical Laboratory calibrated condensers, inductances, thermo-galvanometers, a cadmium cell giving a constant voltage stand out to the eye at the very threshold and can be picked out from the picture.

The Company use four aerials for general testing—one for transmission and three for

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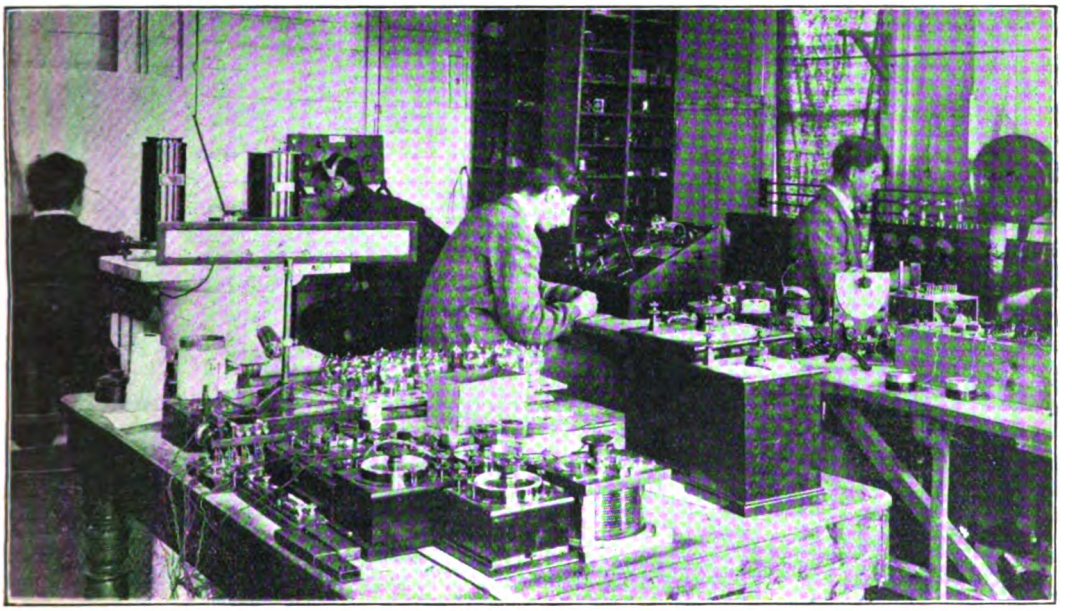
reception. The first of the aerials used for reception is 60 to 70 ft. high and is as efficient as it is possible to make it. The second is constructed to correspond as nearly as possible with many of the aerials in common use on many private houses where space is necessarily restricted and is low down on the roof. The third almost baffles description and has been deliberately thrown up in as shoddy a manner as could be conceived. It has high capacity, is leaky, has an uncertain earth connection and, generally, is a thorough disgrace to the neighbourhood. If

numbers of the machines used and the operators' names. The present total of employees is about 750.

The wireless devices marketed by the Company include honeycomb coils in two mountings and innumerable sizes, vario-couplers, filament rheostats for every kind of valve, potentiometers, fine tuning devices such as the "Vernob," the vernier friction pencil and anti-capacity extension handle, and electric soldering irons which, by the way, are also used by the employees in production.

Many new lines are constantly being



A corner of the research laboratory at the Igranic works.

apparatus will function on this creation then it should certainly work anywhere. Yet all the varied products of the radio factory are actually tried out on it!

Girls form a large proportion of the employees, but the work is so arranged that each individual becomes a specialist in the particular job allotted and there is a wonderful system of history cards by means of which any particular article can be traced through from the very start of manufacture to the moment of despatch from the works. These cards contain a mass of detail, including the

brought out and we can only touch on one or two which are of particular interest.

The "Unitune" aperiodic fixed coupler for short wavelengths consists of a plug-in coil of the usual external appearance but with primary and secondary windings of honeycomb duolateral formation. The aerial portion of the coil (primary) is aperiodic, whilst the secondary is tuned by a 0·0005 condenser in shunt. No alteration to the wiring of one's set, other than the removal of the aerial and earth leads from their customary terminals and their attachment to two special

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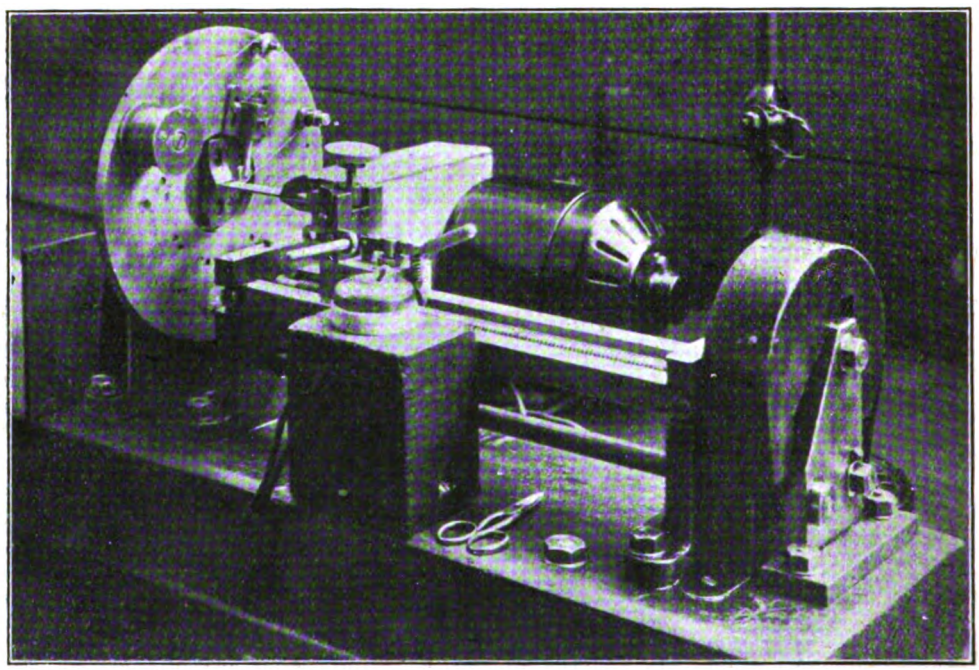
terminals on the inside of the coil, is necessary. So great has been the initial demand for this coupler that Messrs. Igranic are unable at the moment to cope with it. In a few weeks, however, supplies should be obtainable without difficulty.

Honeycomb high frequency transformers, are deserving of particular mention. Being rather pleased with the appearance of these transformers, we selected a set at random and took them away for test. On plugging into the set one is struck with their stability in operation and the four-pin plug, with diagram of connections on each coil, fits any standard valve holder. It is recommended that the tuning condenser be shunted across the secondary windings (filament terminals of valve holder). Self-capacity between the insulated windings is remarkably low.

The wavelength range covered by four of these transformers is from 250 to 3,000 metres with a 0·0005 mfd. condenser in shunt; but the largest transformer can be conveniently tuned with a 0·001 mfd. instrument and thus add to its effective wavelength range.

Our third photograph shows a close-up of the method of winding the potentiometer resister elements which is of interest.

Before we left, Mr. Curtis enquired if we had any special questions to raise or any suggestions or criticisms to offer. We raised immediately the subject of a variable grid-leak which will give good performance, even regulation and consistent results.



One of the potentiometer winding machines.

We were shown an article upon which they are now working and which has occupied some considerable time in the Research Department.

We are not permitted to divulge the details of construction at the moment, but Mr. Curtis has been good enough to promise to send one of the first batch produced for test. We shall hope, therefore, to give readers some further details and a report on its performances at a later date.

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THE CRYSTAL AS A GENERATOR AND AMPLIFIER.

By VICTOR GABEL.

(*Concluded from page 5 of previous issue*).

Oscillating Crystal Circuits.

THE circuit of a generator was given in *The Wireless World and Radio Review* of June 11th, No. 252, page 300, but it is reproduced again in Fig. 5 for convenience of reference.

A circuit in which oscillations of audible frequency are produced is represented by C_1 and L_2. If the switch S is set in the upper position and the telephones donned, a generating point on the crystal may be found by trial. After the oscillations have commenced the switch may be thrown into the lower position, when oscillations of high frequency will be obtained. It is of importance that the switch should contain a dead contact in the centre (as shown on the diagram), for otherwise the oscillations may cease during the process of switching over.

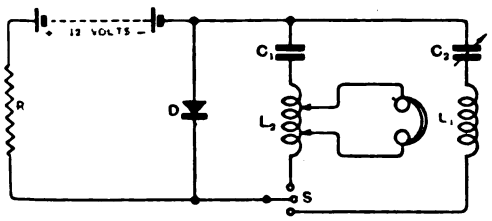

Fig. 5. Circuit for setting up oscillations.

It will be seen that the circuit also contains a resistance R in the direct current lead. The purpose of the resistance, which is indispensable in all circuits with generating crystals, is as follows. Let it be assumed that a milliammeter of low resistance has been included in the circuit Fig. 1 instead of a galvanometer with a resistance r^1 as shown; in other words, that the battery is applied directly to the detector.

Under these circumstances the contact would always be at the potential applied from the potentiometer, and it would thus be impossible to obtain a negative characteristic. The presence of resistance allows a free change of the potential applied to the detector, therefore the sum of the voltages at D and R (Fig. 5) must be constant, the potential difference at D changing in accordance with the strength of the current, it being always adjusted by corresponding changes of the voltages on the ends of the resistance.

Experiments have shown that R must always be higher than the average negative resistance of the detector, which is usually no higher than 900 ohms. The minimum value of R, therefore, is about 1,000 ohms. In order to choke back the oscillations from passing through to the battery circuit, it is desirable that the resistance should possess an inductance. For this purpose it is advisable to wind R (Fig. 5) of thin copper wire on an iron core. It is, of course, possible to include a separate choke coil of such a resistance that with the resistance R the total does not considerably exceed 1,000 to 1,500 ohms. The resistance of the inductance L_2 should also not exceed 50 ohms.

The following conditions found by means of experiments must be approximately fulfilled in order to be certain that high frequency oscillations will commence when the switch is brought over to the lower position:—

$R_2 = R_1$ and $\frac{L_1}{L_2} = \frac{C_2}{C_1}$ where R_2, L_2 and C_1 are the resistance, the inductance and the capacity respectively of the audio-frequency circuit and R_1, L_1 and C_2 are the resistance inductance and capacity of the high frequency circuit.

Referring to Fig. 6, a circuit useful for obtaining very short waves, it was found that the oscillating energy might be considerably increased by including a condenser C_3 in parallel with the generating detector D. For short waves of the order of 200 metres, 0·002 mfds. capacity was found a suitable

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value, 0·004 mfds. suiting waves between 200 and 2,000 metres. A further advantage of including this condenser is that the purity of the oscillations obtained is considerably

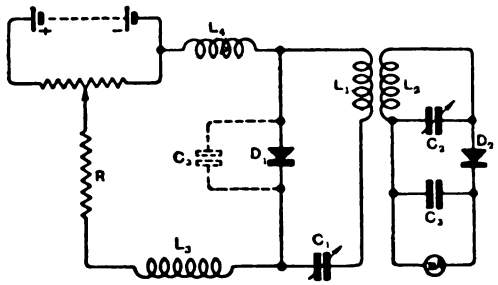

Fig. 6. Oscillating crystal circuit. C_2 is introduced and increases the amplitude on short wavelengths.

increased. Where waves of over 2,000 metres are being dealt with, the condenser becomes no longer necessary. Fig. 7 shows a complete circuit for a C.W. receiver.

In view of the previous remarks the operation of the circuit should be easy to follow. The low resistance telephones. Should the telephones possess a resistance of 50 ohms or lower they may with advantage be included in the oscillating circuit instead of across the coil L_1.

The inductance L_2 is wound with copper wire not finer than 24 S.W.G. It consists of 220 turns wound on a former of 12 centimetres diameter with a length of 10 centimetres. Such a circuit is suitable for reception on wavelengths of from 2,000 to 15,000 metres. A circuit in which a zincite detector serves simultaneously as a generator of continuous waves and as a detector is shown in Fig. 8. By means of the potentiometer P it is possible to adjust the operation of the crystal in such a manner that it can work, as has been previously explained, on a point of the characteristic where it detects and where simultaneously its resistance becomes practically equal to the resistance of the antenna.

The note of spark and telephony stations will not be affected in any way, but only

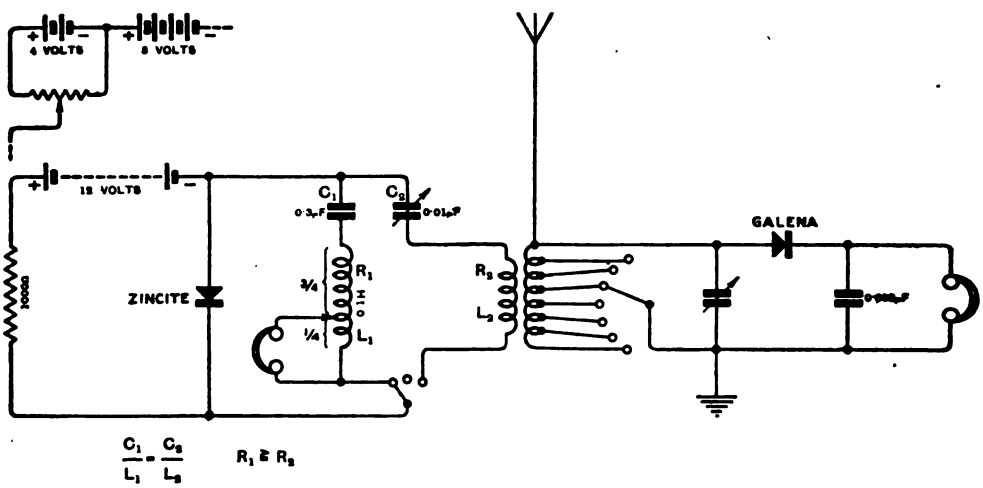

Fig. 7. Receiving circuit for C.W. reception, using a crystal oscillator for heterodyning the incoming oscillations

The value of the heterodyne battery should be 12 volts, the current being about 3 milliamperes. For convenience the last 4 to 5 volts may be controlled through the agency of a potentiometer having a resistance of about 400 ohms. The coil L_1 having an inductance value of 0·1 henry and a resistance of 50 ohms is preferably wound with 28 S.W.G. copper wire, a section of about a quarter of the turns being shunted by amplified, the operation being similar to that of a valve amplifier with reaction.

It may be noticed that the frequency of the oscillations generated by the crystal, changes slightly with the adjustment of the potential through the potentiometer.

Waves shorter than 1,000 metres are received, using the circuit shown in Fig. 9. In this circuit the condenser C serves for increasing the oscillation energy, its capacity

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being about 0·004 mfds. In the circuit of a receiver shown by Fig. 10 the telephone receivers serve simultaneously for discovering the generating point by means of the oscillating circuit and for the reception of C.W. This dual use is accomplished by means of the double-pole switch S. Placed in the left-hand position it brings the telephones into the low frequency circuit L_2, C_2, and when connected to the right-hand contacts the telephones serve for the reception of the oscillations of the antenna. This

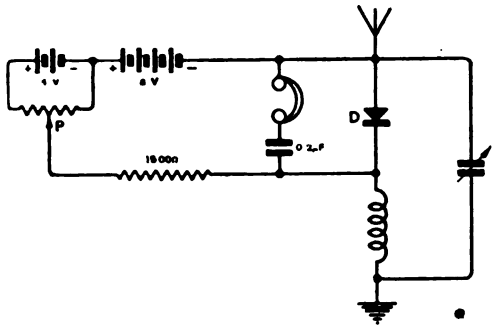

Fig. 8. Regenerative crystal receiving circuit for long wave reception.

switch must also be provided with a dead contact in the centre. The choice of the values of the inductances and capacities must depend on the same considerations as have been dealt with above.

A zincite detector can also be made to serve as an efficient amplifier. It has already been seen in the circuit of Fig. 8 that it is possible to obtain an amplifying process by means of a crystal, in a similar manner to a valve amplifier using reaction. It is, however, possible to arrange such a circuit when the

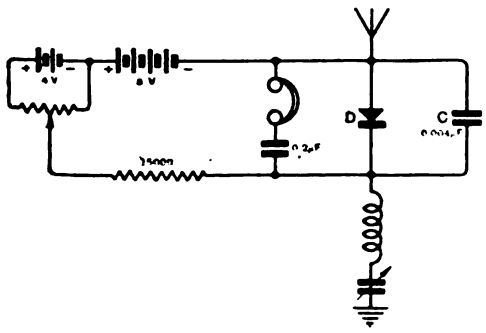

Fig. 9. Short wave regenerative crystal receiver.

detector itself amplifies the energy received in the antenna. Figs. 11, 12 and 13 are examples of such circuits.

An amplifier comprising a high frequency circuit C_1, L_1, which serves as a tuner and

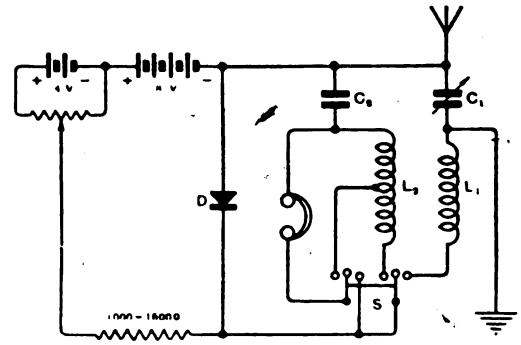

Fig. 10. A switch is here introduced so that the crystal can be adjusted to an oscillating condition.

a low frequency circuit L_2, C_2, is shown in Fig. 11. In order to operate the amplifier successfully the potential applied to the crystal must be high enough to get the

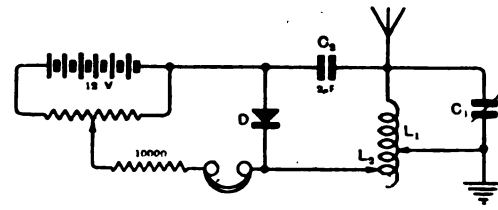

Fig. 11. Another regenerative circuit.

detector almost to a generating state, but generating must not commence, because the circuit produces oscillations of audio-frequency. A crystal can detect and at the

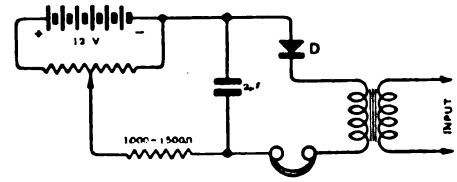

Fig. 12. An L.F. amplifying circuit.

same time produce amplification. A 15 to 1 amplification is even possible if the potentiometer is so adjusted as to keep the rise and fall of the oscillations of the circuit C_2, L_2, in phase with the received oscillations.

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A low frequency amplifier is shown in Fig. 12, which, however, gives only a low amplification factor.

The last, Fig. 13, represents the circuit of an amplifier working independently. It will be seen that the zincite detector-amplifier is connected straight on to the aerial. The receiver is used with an ordinary detector D_2, C L being the tuner.

In all instances where the detector is used as a generator or amplifier it is advisable to use telephones of low resistance of between 100 to 250 ohms.

Using some of the circuits described, it has been possible to achieve transmission over a distance of one mile. On both sides the crystal served simultaneously as a generator and detector, so that even duplex transmission was possible.

This new sphere for the use of a crystal opens up a wide field for investigations of great scientific value, and it is a matter in which both the amateur and advanced experimenter can participate. It may be mentioned that any practical developments produced would be of extreme interest to those who are at present working along these lines.

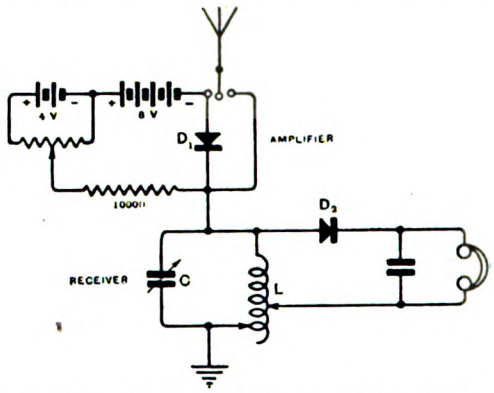
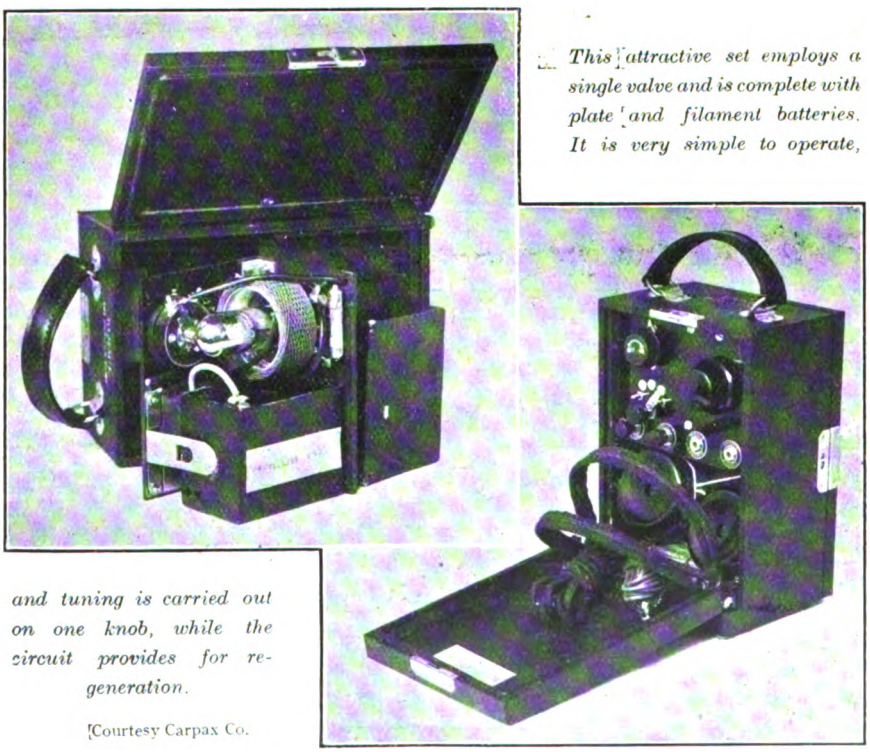


Fig. 13. Another oscillation amplifying circuit.

THE REALLY PORTABLE SET.



This attractive set employs a single valve and is complete with plate and filament batteries. It is very simple to operate, and tuning is carried out on one knob, while the circuit provides for regeneration.

[Courtesy Carpax Co.

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PATENTS AND ABSTRACTS

Loud Speakers.

(1) In loud speakers of the type having a sound horn, a compact design may be obtained by coiling the horn round a portion of the instrument in such a way that the centre of gravity of the horn is substantially

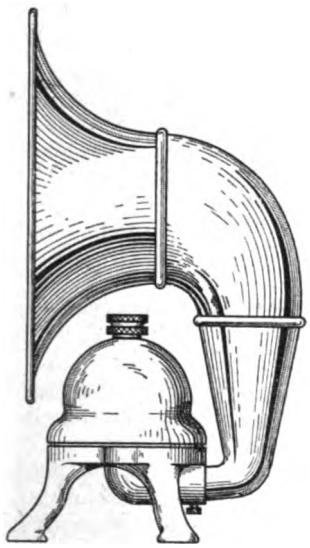

Fig. 1. A compact loud speaker suitable for mounting in a compartment of a cabinet type receiver.

vertical over the centre of gravity of the instrument. Where the horn enters the instrument at one of the sides the horn may conveniently be coiled horizontally round the instrument and then led up the side to spread out over the top.

One method of construction* may be seen from Fig. 1. A compact arrangement of this type is very suitable for mounting in a compartment of a cabinet type receiver.

(2) A good method of securing the diaphragm of a loud speaker is to clamp it between the edge of the housing surrounding the mechanism and the element which constitutes a cover for the open end of the casing and provides a means of communication between the diaphragm and horn.

In the portion of the loud speaker sketched* (Fig. 2), 1 is the case of the instrument which contains the electromagnet 2. The diaphragm 3 is secured by screwing a massive block casting 4 to the case of the instrument, the screws passing through slots provided in the edge of the diaphragm.

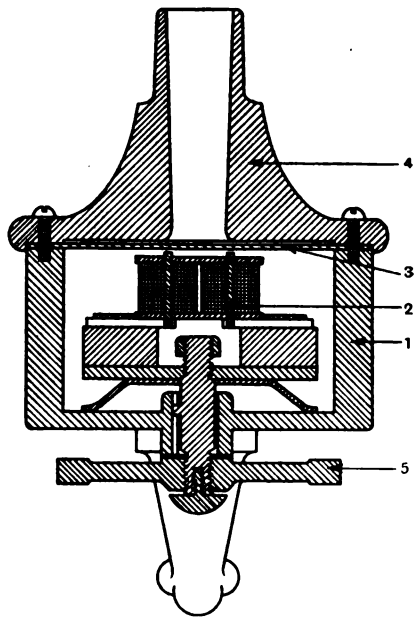

Fig. 2. A sectional view showing the construction of a loud speaker.

The position of the magnets with respect to the diaphragm may be adjusted by turning the knurled knob 5.

*British Patent No. 219,095, by The British Thomson-Houston Co., Ltd.

*British Patent No. 219,070, by Johnson and Phillips, Ltd., and W. H. Johns.

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A Novel Valve.

In ordinary receivers or transmitters it is usual to connect a coil in the anode circuit and another in the grid circuit and to couple them for the purpose of obtaining reaction effects. It is proposed* to dispense with these coils and to construct the anode and grid of the valve of spirals of wire in such a manner that the magnetic coupling between them will suffice to give the desired reaction effect. Preferably the anode and the grid each are provided with two terminals to allow circuit connections being made at each end. The improved valve may be used without any external coupling or inductances for the generation of short or long waves. If necessary, the inductance of the grid and anode circuits may be increased by connecting external inductances. The use of external inductances will also permit of the coupling between anode and grid being varied.

Direction Finding System.

This invention refers to wireless direction finding systems, in which in the determination of a bearing, the occurrence of minimum current flow in a coil or circuit is noted by the effect produced in telephone receivers, or by an indicating instrument.

An improvement in this method† consists in arranging the apparatus to determine the occurrence of minimum flow in a circuit by causing the current to maintain a valve paralysed except when the current is at or near its minimum or zero value. One method may be explained with reference to Fig. 3. For determining the direction of a transmitting station, two coils or loop aerials (1, 2) are employed, these loops being fixed at right angles to one another, with their planes vertical. The direction of the transmitting station is determined by ascertaining when the current in the first loop (1) is a minimum; that is to say, when this loop is in such a position that the direction of the transmitting station is perpendicular to the plane of the loop. The plane of the second loop (2) is then directed towards the transmitting station. The terminals of the first loop, across which a tuning condenser 3, is connected, are joined respectively to the grid and through a potentiometer, 4, to the filament of the control valve 5. The anode of the control valve is joined to the filament through a battery 6, in series with a resistance 7, forming a potentiometer. A tuning condenser 8, is joined across the terminals of the second loop, and these are connected respectively to the grid of the main valve, 9, through a grid leak and condenser and to the movable contact of the potentiometer (7), in the anode circuit of the control valve. The terminal of the potentiometer

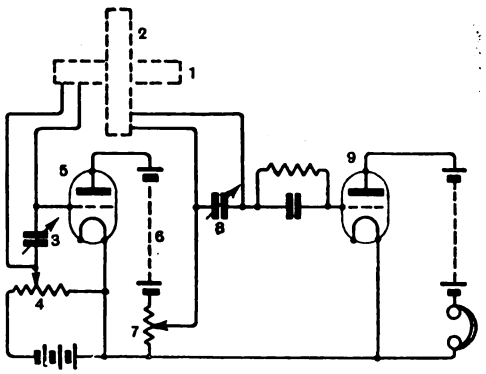

Fig. 3. Showing how a control valve is employed in the receiver of a direction finder.

which is connected to the filament of the control valve is connected to the filament of the main valve.

The movable contact of the potentiometer is so adjusted that except when the current in the first loop aerial has a minimum value, the potential of the grid of the main valve is such as to paralyse this valve. As the loop aerial is moved away from the position in which the current is a minimum, the main valve becomes paralysed, and no sound is heard in the telephone receivers. By using two loops in the manner described, a sound is produced at or near the minimum point only if radiation is being received from the transmitting station.

* British Patent No. 220,388, by J. Robinson and W. H. Derriman.

† British Patent No. 220,029 by J. Robinson and G. J. R. Joyce.

AUSTRALIAN AMATEUR PROGRESS.

We are glad to hear from Mr. Philip Renshaw of the rapid development of the Wireless Institute of Australia, and particularly of the New South Wales Branch, of which he is Hon. Secretary. This division has now incorporated practically the whole of the clubs in New South Wales and is the mouthpiece in all amateur wireless matters in Australia.

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THE POSITION OF THE SCIENTIFIC AMATEUR.

AUTUMN PRESIDENTIAL ADDRESS TO THE RADIO SOCIETY OF GREAT BRITAIN.

By Dr. W. H. ECCLES, F.R.S.

(*Concluded from page 8 of previous issue*).

THE licence which the Postmaster-General must grant to the amateur may be "subject to such special terms, conditions and restrictions as the Postmaster-General may think proper, but shall not be subject to any rent or royalty." I think much of the trouble that has arisen comes from the last sentences. For example, they seem to have been interpreted to mean that the Post Office may restrict the licence to the use of a station for a few minutes a day between specified times and on a very low power, thus depriving the licence of nearly all utility. The phrase "terms, conditions and restrictions" has been applied to compel applicants to disclose completely the object and the method of their proposed experiments. Now there are some experiments for which the method can be foreseen and some for which it cannot. For most of them the method and the apparatus must be evolved as we go along. Hence the applicant for a permit to try experiments of this latter class is refused his licence—which is quite contrary to the spirit and the letter of the Statute. The ultimate consequence is that some surprising anomalies have arisen. For instance, at the beginning of the year the Council sent forward a select list of names of applicants of whose *bona fides* and competence the Council was confident. The list included among other experienced wireless amateurs one who has graduated in electrical engineering at a great College of the University of London. All the applications were rejected. At the same time the Council heard of licences being granted to inexperienced beginners with inferior qualifications. I am informed that the solution of this mystery is that some of the successful applicants for permits copy a few pages out of a technical treatise or published paper and present it as a description of their proposed research.

Another instance in which the Society has tried to assist is that of a pre-war transmitter in the North of England who has retired from business and is anxious to return to the study of the variations of signal strength produced by the atmosphere. His application has been refused although, he tells us, beginners in his neighbourhood, some of them his pupils in the art, have been granted permits since.

VALUE OF EXPERIMENTS CANNOT BE KNOWN IN ADVANCE.

Even in those cases where a problem can be delimited and a method tentatively suggested, the desire of the Post Office to weigh the scientific value of the experiment and method before granting the permit is unpractical. It is an axiom of science and invention that such adjudication is worthless. It is a responsibility that no man of science, no scientific body would presume to undertake. The unexpected happens and is valuable. In short, it is much easier to spot the winner in a handicap than to forecast the result of an experiment.

THE LICENSING FEES.

While I am speaking of the Act I might refer to the enactment that the licence granted for experimental purposes shall not be subject to any rent or royalty. The experience of this Society in connection with its own experimental station is as follows. The original licence was required to cover three and a half months' operation and was granted on the 7th December last. The licensing fee of £2 and a royalty of £2 10s. for a complete half year had to be paid. The permit restricted the use of the station

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to 15 minutes on any one night between the hours of 1 a.m. and 7 a.m., and the power was limited to 1 kilowatt. It is to be regretted that so severe a curb should be imposed upon altruistic scientific work. It is reminiscent of the dark ages. At the present moment the position is that the Society is prohibited from using its station, even for helping amateurs to tune their apparatus correctly, unless the Society consents to pay another £2 10s. in royalty for the remainder of the year.

HOW ANOMALIES HAVE ARISEN.

Perhaps the anomalies I cite above have grown up as the result of a system adopted long ago and have not been brought plainly before the authorities. I think it will be universally agreed that the system ought to be revised so as to remove them. An analogous case and its remedy is to hand. It will be remembered that at the beginning of the broadcasting movement in this country the Post Office applied the Wireless Telegraphy Act to compel all broadcast listeners to buy their apparatus from a specified group of firms. The upshot was that the home constructor arose in his thousands and defied the regulation. The Post Office thereupon tackled the problem afresh and rectified the mistake. This is exactly analogous to the present difficulty with the amateurs, but in this case the regulations are hindering scientific discovery, are robbing the best men of opportunities for learning advanced technique, are diminishing our wireless prestige relative to other nations, and will ultimately react adversely on the output of invention and technical improvement. The remedy is easy; it is to recast the regulations in the light of the experience of other progressive countries. British transmitters would then attain the same measure of freedom and be put under the same obligations as their fellow amateurs in America, France and elsewhere.

OTHER PROBLEMS BEFORE THE COUNCIL.

I have dwelt at some length upon the licensing anomalies because of the great importance of this matter from the national and scientific point of view; but the Council have had many other problems before them. This has been a year of re-organisation, and therefore a very arduous one for the Council, which has in fact held thirty-four meetings in the twelve months. Their work has resulted in many improvements. The first great improvement consisted in concentrating all the work of the Society in a central office and in appointing a Secretary. Next, a number of Standing Committees were formed to deal with much of the detail work of the Society. The amount of devolution can be seen from the list of names of these Committees: The General Committee of Affiliated Societies, the Membership Committee, the Papers Committee, the Licensing Committee, the Publicity Committee and the Standards Committee. Full particulars of these Committees will be published in the Annual Report. Besides these there are permanent Committees of the two new Sections of the Society namely: the Schools Radio Society and the T. and R. Section. Since January the Committees have altogether held more than forty meetings.

The activities of the above named Committees are more or less invisible, but the scientific meetings of the general membership of the Society constitute an equally good record. During the twelve months there have been ten ordinary meetings with an average attendance of ninety, nine informal meetings with an average attendance of forty, and eleven meetings of the Transmitter and Relay Section with an average attendance of fifty-five.

Among the greater of the public efforts of the Society during the past twelve months I must mention the organisation of the Transatlantic tests last autumn. Mr. Coursey's report was published in May last and is familiar to all members. Another important piece of work was the transmission and reception tests conducted in an express train on the London and North Eastern Railway, organised by Messrs. Child, Coursey and McMichael. Full reports of these tests have now been published and the thanks of the Society duly tendered to all who had assisted.

A MEMBERSHIP BADGE.

Another matter which has engaged the attention of the Council has been the choice of a badge for the Society and its affiliated societies. In order to obtain suggestions the Council offered a prize of £5, reserving the right to use any or none of the suggestions in any manner. A large number of designs and ideas were sent in, many of them beautifully executed. They will be exhibited at the Society's Stand at the Exhibition

(*Continued on page* 58.)

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A wireless, electrical and cinema exhibition is to be held in the Ice Palace, Madrid, from December 6th to 26th.

* * * *

H.M. The King of Siam has, we understand, purchased a Western Electric Supersonic Heterodyne Receiver with which he hopes to enjoy **2 LO**'s programmes.

* * * *

A course of lessons in organ music is being broadcast from l'Ecole Supérieure des P.T.T., Paris.

* * * *

The Irish Free State is shortly to have a broadcasting system with a main station in Dublin and relay stations in Cork and other centres.

* * * *

The new relay broadcasting station at Stoke-on-Trent is to be opened on October 21st.

* * * *

The Japanese Government have issued broadcasting regulations permitting the establishment both of high and low power stations. These will work on bands of 360 to 385 and 215 to 235 metres respectively.

* * * *

MANCHESTER'S WIRELESS EXHIBITION.

Tuesday, October 14th, sees the opening of the first Wireless Exhibition to be held in Manchester. Organised under the auspices of the *Manchester Evening Chronicle*, this interesting show will be staged in the Exhibition Hall, Deansgate, and will remain open until Saturday, October 25th.

Leading wireless firms have taken stands and the result will be a very fine representative collection of modern apparatus.

The technical direction of the exhibition has been undertaken by the Manchester Radio and Scientific Society.

An interesting exhibit will be that of the Avro Company, of Manchester, who have kindly lent an aeroplane which will be fitted with wireless; a railway compartment and one of several motor-cars exhibited by the Ford Company will be similarly installed; and there is to be a duplicate of a ship's wireless cabin, fully equipped.

As a result of cordial co-operation with the B.B.C., there will be frequent transmissions for the benefit of the Exhibition during the fortnight, and amateur transmissions by leading Manchester amateurs are arranged for times when the Broadcasting station is closed down.

Not of least importance are the three constructional competitions organised by the *Evening Chronicle*, and for which prizes to the total sum of 100 guineas are being offered.

KDKA GETS BUSY.

In support of the claim of **KDKA** of being "the World's Premier Broadcasting Station," we have received a report of remarkable reception of the station on 60 metres by Mr. L. W. Murkham, of Stratford, London, E.

The occasion of this reception was the America-Spain tests and on Thursday, September 18th, our correspondent received the complete programme of the Pittsburg station, using a detector valve and one L.F. stage, his aerial being a 20-ft. wire hung across a room. The addition of a further stage of L.F. afforded good loud speaker strength of excellent quality.

Further tests were made on the following evening, when reception was found to be quite clear on earth alone. Indeed **KDKA** was still audible with both aerial and earth disconnected.

FRENCH COURSE FOR HOME CONSTRUCTORS.

It is a testimony to the success of the scheme the French School of Practical Electricity is on October 20th opening its fourth course of evening classes for those who desire instruction in the equipment of private wireless installations. The course extends over two months, and successful students are granted a diploma.

SOVIET CALL LETTERS.

The Russian Soviet wireless stations are being given call signs commencing with R. According to recent information, the following have been allocated:—Odborsk, **RAN**; Saratoff, **RAP**; Simferopol, **RAT**; and Kharkof, **RAZ**

BELGIAN AMATEURS PLEASE NOTE.

To facilitate the interchange of reports, Belgian transmitters are asked to send particulars of their call signs, etc., to Monsieur L. Heurotay, President du Radio Club Belge de l'Est, 56 Crapaurue, Verviers, Belgium.

D.F. IN FOG.

An example of the value of direction finding at sea was furnished by the recent experience of the *Melita*, of the Canadian Pacific Service. Between Quebec and Newfoundland a dense fog was encountered and danger arose owing to the proximity of another large vessel, not fitted with D.F. apparatus, making for the same port.

In this delicate situation the *Melita* succeeded in accurately determining her own position and that of the other vessel, and in giving the latter her bearings. When the fog lifted momentarily,

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visual bearings were taken which confirmed the *Melita's* readings in every respect.

GENERAL FERRIE AS AUTHOR.

General Gustav Ferrié, Chief of Radio Communications of the French Army, has recently completed a short book on the history and purpose of wireless. In the course of his remarks the General strongly advocates perseverance in short wave work, for which he sees a great future. A section of the book contains a highly eulogistic review of the work of amateurs throughout the world. Copies are obtainable, we understand, from the T.S.F. Revue, 35 Rue Tournefort, Paris.

WORLD'S FOREMOST CLUB ?

A highly satisfactory annual report for the season 1923-1924 has been issued by the Milwaukee Radio Amateur's Club. Much of the success which has made the past year a record one is attributed to the spirit of co-operation among members, and Mr. F. W. Catel, Secretary, makes the daring assertion that the club possesses the distinction of being the foremost purely amateur club in the world.

The membership committee has been very active and has secured 97 new members during the year.

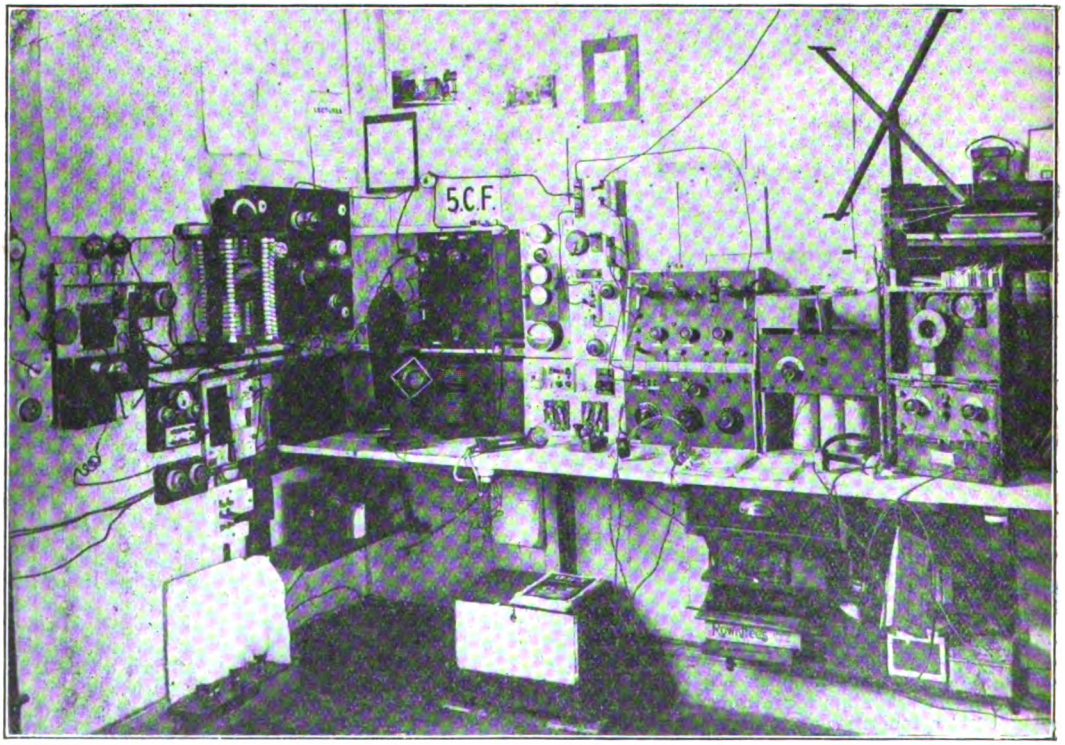
THE PARIS CONCOURS LEPINE.

During the recent Paris Concours Lepine, an exhibition devoted to the productions of small inventors, demonstrations in transmission were given by MM. Jacques Chatenet and Pierre Delauney (**8 BS**). In spite of the heavy atmospheric disturbances at present prevalent in France, these transmissions were heard clearly by Finnish **1 NA**.

SWEDISH AMATEUR TRANSMITTERS.

The following list of Swedish transmitters supplements that appearing in our issue of September 24th.

SMYY	H.S.G. Svensson, Kronudden	Waxholm
SMZA	Nässjö Radioklubb, Radhusgatan 26	Nässjö
SMZD	Jönköpings Radioklubb, Villa Annero	Jönköping
SMZF	G. H. d'Ailly, Skanegatan 31	Göteborg
SMZH	John Lundström, Kv. 15, Tomt 3	Kiruna
SMZI	Claes Fleming, Stureplan 2, Motoryachten Borgila, IV ..	Stockholm
SMZJ	Claes Fleming, Stureplan 2 ..	Stockholm
SMZK	Falu Radioklubb	Falun
SMZL	Erik Holm, S. Langgatan 10 ..	Kalmar
SMZN	Georg Holmlund, Rosenlundsgatan 3	Göteborg
SMZO	O. Mogensen, Svärdsjögatan 9	Falun



A well-arranged transmitting station owned by Mr. F. G. S. Wise, of Crouch End, London.

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Radio Society of Great Britain.

FORTHCOMING MEETINGS.

An informal meeting of the Society will be held at 6 p.m. at the Institution of Electrical Engineers this evening (Wednesday), when Mr. A. Hinderlich will open a discussion on "Crystals."

The Transmitter and Relay Section will hold an informal meeting on Friday, October 10th, at 6.30 p.m., at the Institution of Electrical Engineers, when Mr. H. L. Kirk will give a talk on "Small Power Transmitters."

DISTINGUISHED LIFE MEMBER.

Members will be interested to learn that an honour has been conferred on the Society by H.R.H. The Crown Prince of Siam, who has become a life member.

AERIAL INSULATION.

Useful hints on aerial insulation were introduced by Mr. J. E. Nickless, in opening a discussion on the subject at an informal meeting of the Transmitter and Relay Section on Friday, September 26th.

The question of aerial insulation had been grossly neglected in the past, said Mr. Nickless, particularly from the amateur's point of view, and the market had been flooded with cheap insulators which in reality were not insulators at all. For instance, the cheap reel type was practically useless in a transmitting aerial and not much better for reception purposes. The shell type was a distinct improvement, but Mr. Nickless stated that he was disinclined to trust any insulator having a hole in the middle through which the wire was passed.

The ideal insulator should provide as smooth a surface as possible, and all sharp corners and curves should be avoided. In fact, every care should be taken to overcome capacity effects. The type of insulator favoured by the speaker was the "mushroom" variety, which was admirably adaptable to all kinds of weather. The mushroom insulator was also capable of surmounting great mechanical and electrical strains, and Mr. Nickless cited an instance in which an insulator of this type was submitted to a voltage of 52,000 without damage.

In the ensuing discussion the respective merits of glass and ebonite insulators were debated, but Mr. Nickless left the impression that for all-round purposes, the porcelain insulator was superior to other types.

RADIO HISTORY.

"Reminiscences of Wireless Telegraphy" formed the theme of an illustrated lecture given by Mr. Sims before the Borough of Tynemouth Radio and Scientific Society on September 25th.

The lecturer took his audience back to the time of Hertz, proceeding to the introduction of the coherer by Prof. Branly, and then to Senatore Marconi's Transatlantic experiements. After dealing with wireless in the war, Mr. Sims described modern wireless working, giving interesting details of the Imperial Wireless Chain.

CAPTAIN ECKERSLEY ON BROADCASTING DEVELOPMENTS.

SOME remarkable developments in connection with long distance broadcasting were foreshadowed by Capt. P. P. Eckersley, Chief Engineer of the British Broadcasting Company, in an address delivered to the Royal Photographic Society on Tuesday, September, 23rd.

Dealing first with the question of morse interference and jamming, Captain Eckersley expressed the contention that the broadcast waveband would, in a year or two, be entirely free from this nuisance. Until, however, this desirable state of affairs was attained, it behoved all listeners to render their sets as selective as possible. The major portion of the complaints came from listeners resident on the South Coast and the suggestion had been mooted that the power of the main stations in that vicinity should be considerably increased with the object of swamping the interference. This, Capt. Eckersley added, would have met with considerable opposition from licence holders who owned sets sufficiently sensitive to receive distant transmissions and who would, consequently, have experienced difficulty in tuning out their local station.

Referring to the question of relay stations, the speaker added that the cost of the erection of main stations in the various industrial centres would have been too high and relay stations were therefore adopted in preference to a few high power transmitters. It was estimated that with the existing main and relay stations and the proposed high power installation in operation, that practically 22 million people would be satisfactorily served, or approximately 50 per cent. of the population of the British Isles. Working on this basis less than 1 per cent. of the population were adequately served in America.

Utilising Marconi's new system of beam transmission, Capt. Eckersley anticipated the time when Great Britain and America would be linked up by wireless and constant and reliable telephonic communication, free from extraneous noises, would be possible. The speaker recalled the time, during the war, when direction finding at night in Salonica was rendered practically impossible through the shielding influence of adjacent hills, the waves appearing to originate from an entirely different source from that where they were transmitted.

At the broadcasting stations every endeavour was made to give equal electrical impulse for equal audibility, so the question of faithful reproduction mainly concerned those at the receiving end. Many telephones were designed to respond chiefly to one particular frequency, as was desirable where morse was being received. The speaker was convinced that the next outstanding development would be in connection with loud speakers and telephones.

6 MP.

Some confusion has arisen owing to the allocation of the call sign **6 MP**, to Mr. O. W. Nicholson, M.P., whose station is situated in Hampshire. This call was originally the property of the Metropolitan Police, but has since been re-allocated. Mr. Nicholson welcomes reports on his signals.

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Calls Heard

Cobham, Surrey (August 20th and September 9th).
English: **2 ASH, 2 BG, 2 CAA, 2 FN, 2 KF, 2 LF, 2 NM, 2 OD, 2 YT, 5 MA, 5 RZ, 5 ZN, 6 AL, 6 TD.** French: **8 AE, 8 AQ, 8 BA, 8 BN, 8 BS, 8 CM, 8 CZ, 8 DA, 8 DI, 8 DG, 8 DX, 8 EN, 8 EX, 8 IP, 8 JM, 8 ML, 8 MN, 8 NQ, 8 NS, 8 OK, 8 RB, 8 RR, 8 RX, 8 SR, 8 TM, 8 UU, 8 VG, 8 WJ, 8 WR.** Dutch: **0 BA, 0 GC, 0 GG, 0 MS, 0 RB, 0 RP, 0 ZC.** Danish: **7 EC, 7 RT, 7 ZM.** Belgian: **4 RS, 4 WR.** Swedish: **SMZS.** Italian: **1 FP.** German: **POZ.** Unknown: **3 AD, 3 CA, 3 XC, P 6 ZU, 1 CKZ, JLPL.** (o—v—o.) (E. J. Martin).

Coventry (from August 20th).
Morse: **2 ZK, 6 MP, 6 TD, 0 AB, 0 FA, 0 MS, 8 FP, 8 DQ, 8 DX, 8 UU, 8 MN, 8 CG, 8 SSU, 8 BN,* 2 AC, SMZP, GB, IFP, 1 OA, 1 P, 2 P, Z8W.** Telephony: **2 AIT, 2 NV, 2 YK, 5 YS, 8 KK.** (o—v—1 and 1—v—1.) * Also on spark R.7.
(H. Maycock, **2 AVD**).

Aberthaw, Glam.
British: **2 DR, 2 DX, 2 KP,* 2 WU,* 5 AK, 5 KO, 5 LS, 5 NW, 5 RQ, 6 BS,* 6 TD, 6 TH.** French: **8 BN, 8 BU, 8 DN, 8 DO, 8 EM, 8 JHL, 8 OK, 8 WL, 8 WZ, 8 SSU.** Dutch: **0 BA, 0 MS, 0 XP.** Others: **1 DO, 3 AD.** * Telephony.
(C. Prosser, **2 ACK**).

Huddersfield (August 26th and September 6th, 1924).
2 CC, 2 DX, 5 BS, 5 MA, 5 OX, 5 TZ, 5 XN, 6 GH, 6 GM, 6 LJ, 6 NF, 6 RY, 0 MN, 0 QR, 0 XP, 8 BV, 8 DO, 8 WJ, 8 WL, 7 EC, SMZP 4 C 2, W 2, 1 NA, C 1 AR. (Reinartz, 1 D.—1 L.F.).
(J. B. Kaye).

Verviers, Belgium (during August).
English: **2 CA, 2 KZ, 2 MK, 2 OG, 2 TA, 5 LS, 5 MA, 5 OC, 5 RQ, 5 TZ, 6 GM, 6 TD.** Dutch: **0 FN, 0 MR, 0 RB, 0 XQ.** Italian: **1 MT.** Belgian: **4 WR.** Danish: **7 ZM.** French: **8 AE 4, 8 BN, 8 BV, 8 CZ, 8 DO, 8 DX, 8 F 4, 8 JHL, 8 KK, 8 OK, 8 RBR, 8 RO, 8 RR, 8 SM, 8 SR.** (R. Pirotte).

West Norwood, London, S.E.27.
2 AIT, 2 AKU, 2 AMB, 2 ARY, 2 AXX, 2 DZ, 2 FV, 2 GW, 2 JB, 2 OA, 2 OF, 2 TF, 2 TK, 2 ZV, 5 CU, 5 DY, 5 NW, 5 VN, 5 XH, 6 BBC, 6 LF, 6 US, 6 ZE, 6 ZZ, 8 BS, 8 BU, 8 DI, 8 EC, 8 ED, 8 EE, 8 EU, 8 EX, 8 FJ, 8 FK, 8 FL, 8 FQ, 8 JG, 8 JHL, 8 LO, 8 MN, 8 MP, 8 NS, 8 OK, 8 PA, 8 PP, 8 RM, 8 SR, 8 TK, 8 TV, 8 VG, 8 VW, 8 XR, 8 ZC, 0 GC, 0 HD, 0 MS, 0 OX, 0 QW, 0 XQ, 0 ZO, YA 11, SMZP, SMZS, SMZV, ARRL, BX, 3 CA, 3 SS, 3 XO, 4 MG, 4 RS, 4 UN, 9 AD, fn INA, fn 2 NM, fn 3 NB. (o—v—1.) (L. H. Thomas, **6 QB**).

London, N.W.2.
English: **2 ABZ, 2 AIT, 2 AKS, 2 ARX, 2 ASH, 2 ATI, 2 BBN, 2 CC, 2 KZ, 2 MG, 2 OA, 2 OD, 2 PY, 2 TF, 2 UV, 2 WJ, 2 XY, 2 YT, 5 BH, 5 CS, 5 EL, 5 FS, 5 GA, 5 IO, 5 JX, 5 LP, 5 MA, 5 MO, 5 MU, 5 OC, 5 OT, 5 QP, 5 RZ, 5 SZ, 5 UQ, 5 US, 5 XH, 6 AH, 6 BY, 6 KI, 6 KJ, 6 LJ, 6 QA, 6 QB, 6 RQ, 6 TD, 6 TM, 6 US, 6 XG.** French: **8 AL, 8 BA, 8 BS, 8 BU, 8 BV, 8 DP, 8 ED, 8 EK, 8 EM 8 EU, 8 FK, 8 FQ, 8 FX, 8 FSF, 8 JG, 8 JL, 8 KK, 8 LO, 8 MN, 8 NV, 8 OK, 8 PA, 8 PP, 8 RX, 8 SY, 8 SR, 8 TV, 8 XY.** Dutch: **0 BA, 0 BQ, 0 BS, 0 GC, 0 KK, 0 OX, 0 PA, 0 RB.** Finland: **1 NA, 2 NM, 3 NB.** Miscellaneous: **ARRL, YA 20, L 0 AA, 7 EO, 3 AD, 1 CF, 4 CA, 3 CA, 4 WR, 2 XAA, GB 1, GB 2, GB 4, GB 5, GB 6, 2 XSS, 2 CAA.** (o—v—o, Reinartz.)
(E. A. Wilson, **6 GM**).

Portseaton, E. Lothian (during August, 1924).
2 CC, 2 DX, 2 OD, 2 JF, 2 JU, 2 KF, 2 NM, 2 XO, 2 XY, 5 FS, 5 GB, 5 LF, 5 OC, 5 TZ, 6 GM, 6 QN, 6 TD, 6 UD, 8 AQ, 8 BN, 8 BV, 8 EX, 8 FN, 8 FQ, 8 FW, 8 KK, 8 ML, 8 RO, 8 UU, 8 XR, 3 XO, D 3 AD, FNZNM, 1 NA, 4 WR, 0 RB, 0 BQ, 4 WR.
(Capt. E. A. Anson, **2 OA**).

AN OMISSION.

In the article in our last issue describing the Dry Cell Receiver, a drilling diagram was shown on page 16, but the dimensions of drills required were inadvertently omitted. These should be as follows, the lettering corresponding with that on the diagram:—

A = ⅛ in. diameter.
B ⅛ in. diameter and countersunk.
C = 5 32 in. ,, ,,
D = Tapped 4 B.A. and 3 16 in. deep.
E = ¼ in. diameter.
F = 3 16 in. diameter.
G = Tapped 2 B.A. and 3 16 in. deep.
H = 5 32 in. diameter.
J = 9 32 in. diameter.

THE POSITION OF THE SCIENTIFIC AMATEUR—*concluded from page 54.*

opening on Saturday. A sub-committee consisting of Admiral Sir Henry Jackson, Mr. Campbell Swinton and myself went through all the suggestions and agreed that no one of them was exactly suited to our purpose. Finally it was decided to combine some of the elements occurring in two of the best designs and to divide the prize. The winners are Mr. Frank W. Taylor of 60 Cleveland Gardens, Barnes, and Mr. H. H. Townley, 26 De Crespigny Park, S.E. Many other of the competitors deserve prizes, but I can do no more than give them honourable mention, together with the thanks of the Society for their efforts. They are Messrs. Adeane of Shepherd's Bush, Bampton of Salisbury, Bassett of Crofton Park, S.E., Bowes of Darlington, Brayshaw of Huddersfield, Church of Hendon, Clamp of Sydenham, Cooper of Acomb, Cumming of Yeovil, Farrar of Cardiff, Flinton of Scarborough, Francis of Barnet, Goundry of Barrasford, Harvey of Bristol, Helps of Bradford-on-Avon, Ibbitson of Sunderland, Larkin of Eltham, Loughlin of Salford, Marshall of Harrow, Mitchell of S. Croydon, Rowell of Gateshead, Sugarman of Abercynon, Wright of Portsmouth and Mysehall of Rotherham.

FORTHCOMING EVENTS.

WEDNESDAY, OCTOBER 8th.

Radio Society of Great Britain. Informal Meeting. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Discussion: "Crystals." To be opened by Mr. A. Hinderlich.

Radio Research Society, Peckham. At 44 Talfourd Road. Discussions: "H.F. Amplification," "Telephones and Microphones."

Streatham Radio Society. At Streatham Hill College, 35 Streatham High Road, S.W. Lecture by Mr. Ward (**2 QS**).

THURSDAY, OCTOBER 9th.

Bournemouth and District Radio and Electrical Society. At 7 p.m. At Canford Hall, St. Peter's Road. Lecture: "Practical Uses of the Valve." By Mr. W. H. Peters, B.Sc.

West London Wireless and Experimental Association. At Belmont Road Schools, Chiswick, W.4. Lecture: "Constructional Details, Part I." By Mr. J. F. Bruce.

Wimbledon Radio Society. Field Day.

Walthamstow Amateur Radio Society. Jumble Sale.

MONDAY, OCTOBER 13th.

Hackney and District Radio Society. At 8 p.m. At King's Hall, Lower Clapton Road, E.5. "Experiments with Frame Aerials."

TUESDAY, OCTOBER 14th.

Manchester Wireless Exhibition. Until October 25th. In City Exhibition Hall, Liverpool Road.

Merthyr Radio and Scientific Society. At Milbourne Chambers, Merthyr Tydfil. Opening Meeting of Session.

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READERS PROBLEMS

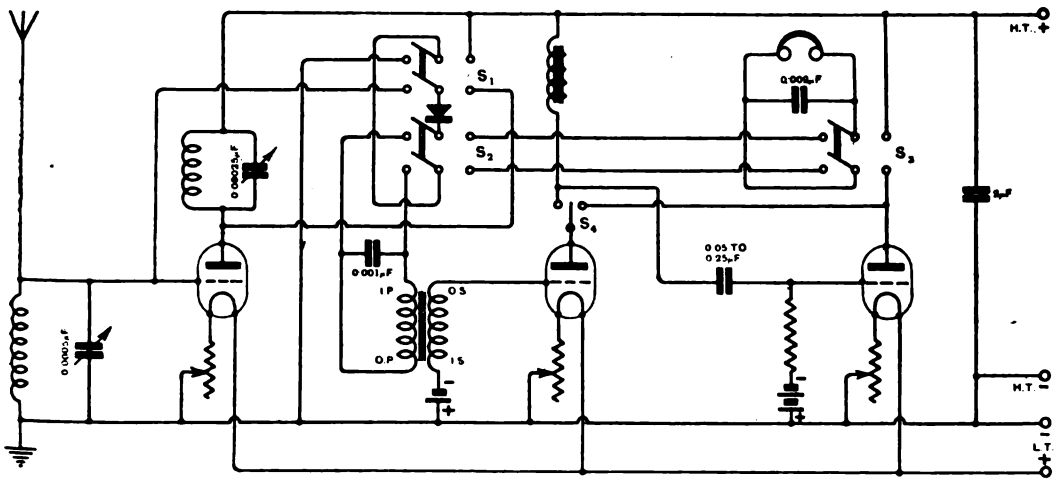
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

CONNECTIONS OF PLUG-IN H.F. TRANSFORMERS.

BEFORE wiring up a valve holder which is to accommodate a plug-in type H.F. transformer in a receiver, it is always wise to check the connections of the pins on the transformer in order to make quite sure that the primary and secondary windings will be connected into the circuit in the correct manner. While the method of connecting the beginnings and ends of the windings varies with different makers, it will be found that in most cases the primary winding is connected between the "grid" and "plate" pins, and the secondary winding between the "filament" pins. It is often possible to obtain a clue as to which are the beginnings and ends of the windings by an examination of the position of the holes leading to the interior of the transformer.

AN EXPERIMENTAL THREE-VALVE AND CRYSTAL RECEIVER.

THE diagram above shows the connections of a receiver employing one stage of H.F. amplification, with crystal rectification and two note magnifiers. Switches have been introduced so that any combination of valves may be used. With switch S1 to the left, S2 to the right, and S3 to the left, the crystal detector alone will be in operation. With S1 to the right and the other switches in the positions mentioned above, the crystal will be preceded by H.F. amplification. When S2 is in the left-hand position, one or two stages of L.F. amplification will be brought into operation, according to the positions of switches S3 and S4. The first stage of L.F. amplification is transformer coupled to the crystal detector, and choke-capacity coupling is employed between the first and second L.F. stages. Suitable values are indicated for the grid coupling condenser. To avoid complication of the wiring, the filament current of valves not in use should be switched off by means of the filament resistances.



An experimental three-valve and crystal receiver.

THE RESISTANCE OF POTENTIOMETER WINDINGS.

IN sending a diagram for criticism, a correspondent asks if the resistance of the potentiometer is too high.

The resistance of a potentiometer cannot very well be given too high a value. The higher the value of the resistance, the less will be the current drawn from the L.T. battery, and as the grid current necessary to prevent oscillation in an H.F. valve is generally only of the order of a few microamperes, a current of 1 milliampere from the

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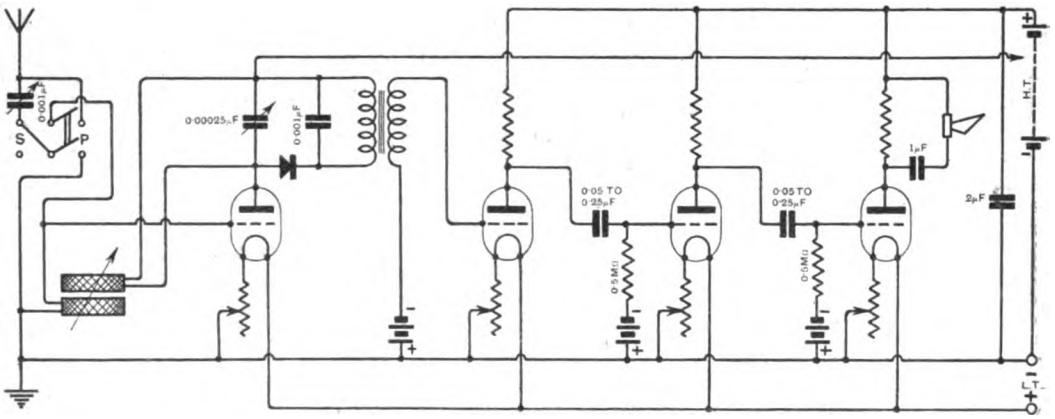
potentiometer resistance would be sufficient to ensure a grid voltage proportional to the position of the slider on the potentiometer. Generally speaking, the potentiometer should be given a resistance of not less than 300 ohms.

A FOUR-VALVE RECEIVER FOR BROADCAST RECEPTION.

THE circuit arrangement given below is suitable for the reception of broadcasting when long range and freedom from distortion are required. One stage of high frequency amplification, together with the use of reaction, ensures the reception of weak and distant stations, while the use of crystal rectification and resistance capacity coupling in the case of L.F. valves is calculated to reduce distortion. It is desirable that the crystal detector should be connected to the first L.F. amplifying valve by means of an intervalve transformer. The distortion introduced by this transformer will be negligible if this component is provided with a sufficient number of turns, and with an iron core of adequate cross section. Suitable values are given where possible, but the values of the anode resistances will depend upon the value of the H.T. battery and the type of valves used.



A four-valve receiver for broadcast reception.

PROTECTION OF THE H.T. BATTERY.

REFERRING to the method of protecting the H.T. battery described on page 656 of the issue of September 3rd, 1924, a reader asks if the 100 ohm resistance connected in series with the H.T. battery would appreciably affect the value of the anode current to the valve.

The effect of this resistance would be negligible, since it bears only a small ratio to the internal resistance of the valve itself, which may be of the order of 50,000 ohms in the case of a general purpose receiving valve. In the event of a short circuit taking place, however, this resistance would be large compared with the internal resistance of the H.T. battery, and would prevent the flow of a destructive current. Another method of protecting the valves is to connect a small flashlight bulb in series with the H.T. battery. This bulb acts as a fuse, and will burn out in the event of a short circuit.

TAPPINGS ON H.T. BATTERIES.

WE have had many queries from readers who have purchased H.T. batteries in which a fixed positive terminal and variable negative tappings are provided, asking how such a battery could be used in a circuit requiring a variable positive tapping.

While this method of marking the tappings is misleading, there is nothing to prevent the use of a variable positive tapping. Every plug on the battery is both positive and negative, according to the end of the battery to which it is referred, so that by fixing the negative plug, the remaining plugs become positive with respect to this fixed tapping, and a variable positive tapping can therefore be obtained.

THE EXAMINATION FOR THE P.M.G.'S CERTIFICATE.

IT is not necessary to pass through a training school in order to take the examination for the Postmaster-General's certificate of proficiency in operating wireless apparatus. This examination is open to all who have filled in the necessary forms; but owing to the fact that part of the examination is of a practical nature, and requires acquaintance with the actual apparatus used on board ship, candidates generally prefer to receive their training at a recognised school, where the apparatus can be manipulated and tested.

A syllabus showing the ground covered by the examination and a copy of the application form are given in *The Handbook for Wireless Telegraph Operators Working Installations Licensed by His Majesty's Postmaster-General*, which is obtainable from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2.

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Wireless Valve Transmitters

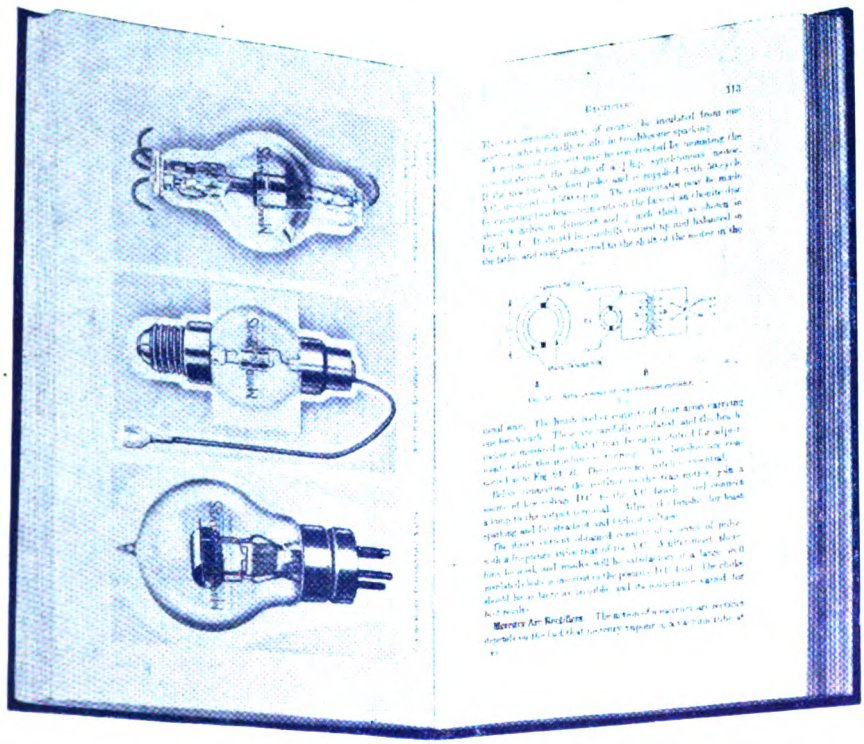
The Design and Operation of Small Power Apparatus

By W. JAMES.

CONTENTS.

(1) *Electrical Principles.* (2) *Inductance Coils and Condensers.* (3) *Alternating Current Circuits.* (4) *The Supply of Power.* (5) *Rectifiers.* (6) *Valve Rectifiers.* (7) *Microphone and Speech Amplifiers.* (8) *The Three-electrode Valve as an Oscillator.* (9) *Modulated Waves and Wireless Telephony.* (10) *Miscellaneous Notes and Measurements.*

The aim of the author in writing this volume has been to deal in turn with each portion of the complete transmitting equipment so that anyone may be able to design and operate his own transmitter. Every possible difficulty which may be encountered has been thoroughly dealt with. The book is divided into 10 chapters and contains no less than 210 photographs and figures. Price **9**s., post 9d. A huge demand is certain. Order your copy at once.



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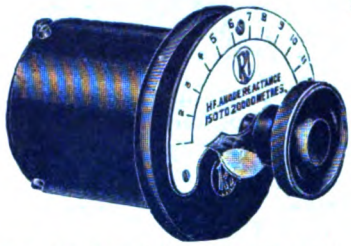
RESEARCH STANDARD



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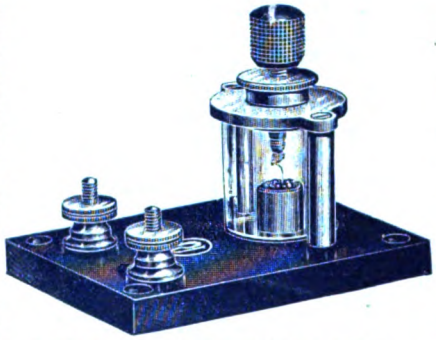

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Combined Variable Intervalve Reaction and Anode Reactance. Wavelength range, **200-4,000 metres** **45/-**

EVERY wireless experimenter looks sooner or later for something more than ordinary results. Each component of his receiving set is reviewed with determination to keep only the best.

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THE WIRELESS WORLD AND RADIO REVIEW

PRICE 4D NET.

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BUILDING AN INEXPENSIVE TRANSATLANTIC RECEIVER

No. 270 [No. 3 Vol. XV]

NEW DEVELOPMENT IN COIL DESIGN

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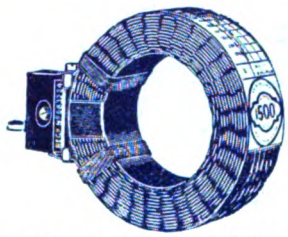

IGRANIC Honeycomb Inductance Coil
(De Forest Patent, No. 141344)
Having the qualities of an ideal inductance coil, and being obtainable in 20 sizes which allow of a selection by means of which dead-end losses are reduced to a minimum—it is the best possible inductance for short wave reception.
20 Sizes to cover wavelengths up to 25,000 metres—for short wave reception they cost **5/-.**

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The well-known American broadcasting stations **KDKA** and **WGY** are transmitting on short wavelengths and on this page will be found details of two Igranic devices which, being built especially for short wave reception, should form part of your receiver if you would experience to the full the thrill of transatlantic reception. They, like all other Igranic Components are obtainable of all reputable dealers.

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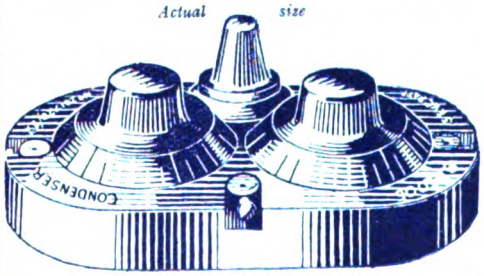
Variable Bridge Condenser

Actual size



New Model A (Mica Dielectric) 14/6

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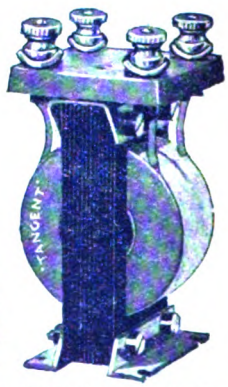

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

THE FALLACY OF A CENTRAL AERIAL.

A REFERENCE has been made recently in the daily press to a proposal made by the Bethnal Green Borough Council for the establishment of a central aerial to supply the district and dispense with the necessity for independent aerials on every house. As we understand the proposal, the central aerial would receive broadcasting from, we presume, the local station, and would re-radiate so that small frame aerials on sets in the vicinity would be sufficient to pick up the transmissions. Such a proposal does not seem to be a practical one for an independent body to attempt. Neglecting technical difficulties altogether, it should be apparent that under the present powers of the B.B.C. that Company has a monopoly for broadcasting in this country, and such a central station and aerial as is proposed, would in our opinion differ very little from a relay station, but an inefficient one in comparison with those already established.

From an amateur point of view a scheme of this kind, if it were ever adopted, would be a matter of continual annoyance, whilst the suggestion of denying the ordinary broadcast listener an aerial would at the same time be depriving him of extending his interests beyond the programmes of his local station.

The reason which appears to have prompted the Bethnal Green Borough Council to put forward the suggestion, has been the unsightly appearance of aerials put up anyhow by tenants to suit their individual tastes. We feel some sympathy with this point of view because undoubtedly aerials of the type one sees so frequently are far from being an attractive addition to the landscape.

It is a pity that at a time when some acquaintance with wireless is so easily acquired, the public should not take the trouble to see that their aerials are put up in such a manner that they need be neither conspicuous nor unsightly. There is certainly no reason why the average broadcast listener should go to the trouble of erecting more than a single wire aerial, and yet even close up to broadcasting stations one frequently comes across multiple wire aerials which almost drag along the roof, and where not the slightest attempt has been made to make a sound and sightly job.

NEUTRODYNE TRANSFORMERS.

EXPERIMENTERS whose wireless interest dates to before the introduction of broadcasting will remember how H.F. transformers of the plug-in type were favoured for use on the wavelengths then in use of 500 metres and above. The amateur wavelength on which there was a good deal of experimental telephony was 1,000 metres and for H.F. amplification the plug-in transformer gave very satisfactory results.

With broadcasting occupying an optimum wavelength of about 400 metres and amateur transmissions employing wavelengths considerably lower, the plug-in type of transformer has lost a good deal of its former popularity, owing to the losses which occur at the high radio frequencies of the short wavelengths.

To a Belgian correspondent we owe the suggestion of an improvement in this type of transformer which may again make it a severe competitor to the now almost universally adopted tuned anode method of high frequency amplification. This new

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arrangement consists of fitting a neutrodyne condenser to the plug-in transformer itself so that the feed-back condenser may be adjusted to a capacity suitable for the wave-length range of the winding, and the other conditions existing in the set. The construction of these transformers fitted with neutrodyne condensers should not prove difficult, whilst the fact that it is necessary to make five points of connection still permits of a design somewhat similar to the old type of transformer as valve holders can now be obtained carrying five valve legs.

The B.B.C. portable transmitter used for relaying animal noises from the Zoological Gardens.

ENTERPRISE OF THE B.B.C.

THE enterprise of the B.B.C. is becoming almost proverbial. There seems to be nothing within their sphere of operation which they are not prepared to attempt.

Any other broadcasting organisation with such powers as have been vested in by the Post Office might have been content to settle down to transmitting programmes appealing to the public taste and to leave it at that, but not so with the B.B.C. The British Broadcasting Company appears to have set out to leave nothing undone which might be undertaken by them to provide novelty or entertainment for the public. We have recently had an instance of this activity in the broadcasting of animal noises from the Zoological Gardens, and however useless some critics may regard this effort, it has certainly made an appeal to popular taste and provided a novel interest. We do not imagine that it is the kind of thing that will enter into the regular programmes of the Broadcasting Company, because after once it has been done the novelty has passed and it could not be said that it was an entertainment to listen to such noises broadcast to the home.

Captain Eckersley has just left for a visit to America and we may expect that on his return other novelties will be produced, and further progress be made in perfecting the technical and perhaps also the entertainment side of the Company's activities. The suggestion has already been made that we may look forward in the future to the possibility of broadcasting in this country the sound of the rushing waters of the Niagara Falls.

THE EDITOR.

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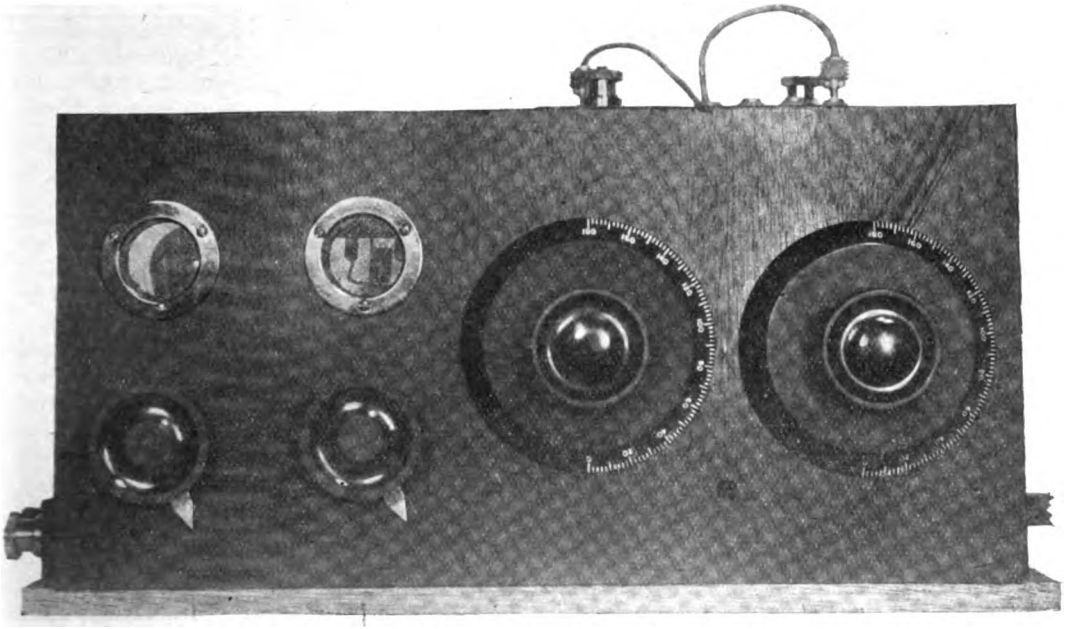

The finished short wave set. The front panel is of mahogany carrying an earthed plate on the back for eliminating hand effects. The panel measures 12¼ by 6 ins. The condenser centres are 3½ ins. apart, and the right-hand condenser, used for reaction control is 2 ins. from the edge. The resistances are 1½ ins. and 3⅛ ins. from the other edge and 1 15/16 ins. from the base.

THE TRANSATLANTIC RECEIVER

50—200 METRES.

The transatlantic tests of the last three years have revealed that it is during the month of November that the American signals are most easily received in this country. A satisfactory explanation of why this should be is not forthcoming, but the fact is certainly well established. This year the number of American stations heard in this country is likely to far exceed that of previous years owing to the progress made in both transmission and reception on wavelengths of the order of 100 metres and the confidence with which the American transmitters have set about the improvement of their stations, spurred on by the astounding successes of last year.

By F. H. HAYNES.

Short Wave Receiving Circuits.

MANY circuits have been put forward specially designed to give good reception on the short wavelengths and mostly bearing the names of American research workers, such as the Reinartz circuit, the Weageant circuit and the Armstrong supersonic arrangement. The Reinartz and Weageant circuits are straight-forward oscillators essentially differing from the well-known single-valve reacting circuit only inasmuch as that a condenser charged by the H.T. battery is connected in the oscillatory portion of the plate circuit with the condenser charging potential fed through a suitable choke coil. The telephone receivers instead of being connected in series with the reaction coil now by-pass the high tension supply, which is fed into the oscillating circuit.

Reference to the accompanying circuit diagram will reveal that the connections very much resemble the oscillatory systems commonly employed in transmitters.

The Reinartz circuit will be seen to consist

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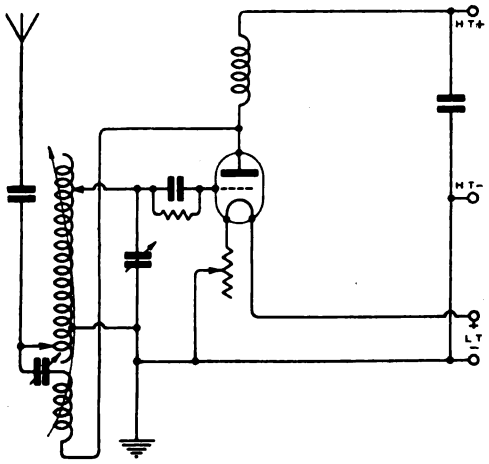
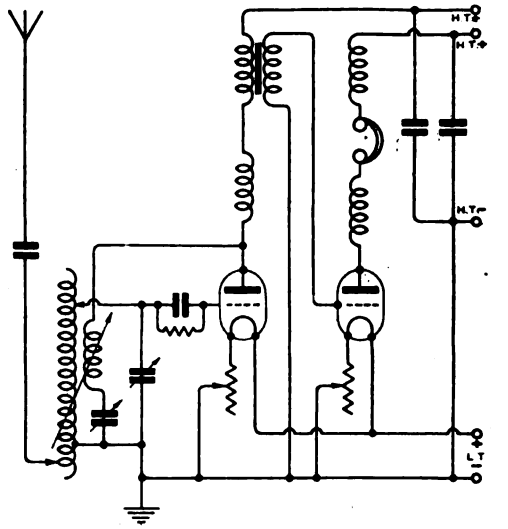
of a loose coupled aerial circuit—loose coupled because the earth point is taken from near the middle of the coil—with feed-back for reaction effected through both a capacity and an inductive coupling, while a portion of the aerial circuit assists in stimulating self-oscillation as its turns are virtually common to both aerial and plate circuits. It is this latter portion of the circuit which tempts one to modify it to give easier manipulation, for the coupled reaction coil in series with the feed back condenser is all that is required to throw the circuit into oscillation and it is essential in short wave work to avoid any change in the tuning of the aerial circuit when the reaction coupling is adjusted.

Making this change brings one to the Weageant circuit where the reaction coil is coupled to the aerial and closed circuit inductances, and is connected to the L.T. minus through a variable condenser. Oscillation with this circuit is brought about in two ways: firstly by tightening the coupling with the reaction coil and secondly by increasing the capacity of the variable condenser, for as its capacity is reduced its impedance to the oscillating current



The Reinartz Circuit in which self-oscillation is set up by a combination of inductance and capacity feed-back, both of which are variable. The suitability of this circuit for short wave work is that reaction may be controlled without appreciably changing the wavelength to which the circuit is tuned.

becomes proportionately less so that the amplitude of the oscillations in the reaction coil becomes greater, producing increased feed-back. It will be observed that this portion of the circuit is really a series-tuned reaction circuit and consequently the inductive reaction coupling must consist of a suitable number of turns and remain fixed



The circuit employed in the receiver here described. It resembles the Weageant arrangement and possesses the special merit that variable inductance coupling of either the closed or reaction circuits is not made use of, self-oscillation being controlled by varying the impedance of the condenser in a series tuned reaction circuit. When once set up the position of the reaction coil is not changed as such adjustment widely alters the aerial tuning.

in position while the wavelength to which the reaction circuit is tuned by the variable condenser must follow the tuning of the aerial circuit.

It is this feature which makes the circuit particularly suitable for fulfilling the most important condition in short wave work, which is that *variable inductive reaction coupling must not be employed.* It must be realised that when oscillation is controlled by changing the position of the reaction inductance with regard to the aerial coil that in doing so the wavelength to which the circuit is tuned may be changed, say for example, from 70 to 110 metres. True, changes in the capacity feed-back will alter the wavelength, but not in the same drastic manner as is produced by a small movement on the short wavelength of two coupled coils.

Short Wave Tuner Construction.

The interpretation of a circuit to practical form when employed for reception on

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wavelengths below 200 metres necessitates much consideration.

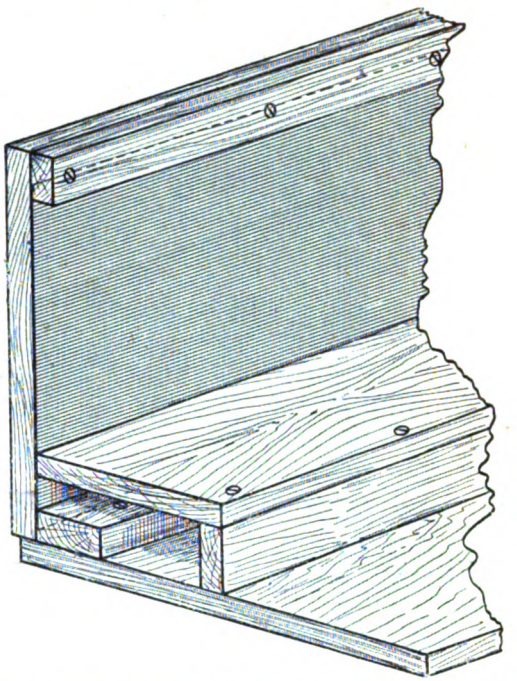
The inductances must be specially designed to give minimum losses. Fixed condensers in the tuning circuits should have air dielectric. Choke coils must be wound to give low self-capacity. The valve in the oscillatory circuit must have low inter-electrode capacity. Operating knobs must be as near as possible at earth potential so that body capacity will not alter the tuning as the hand advances towards the instrument.

The construction of the tuning inductances was described in the previous issue, while the reaction inductance is a basket coil wound with 25 turns of No. 22 D.S.C. wire on a boss diameter of 2½ ins. Variable inductive reaction coupling is arranged, though final reaction adjustment is carried out entirely on the reaction condenser. The position of the reaction coil must be movable with regard to the aerial and closed circuit coils as the latter are tapped, but when the best position of reaction coupling is found, no further adjustment in the process of tuning is necessary.

The construction of the air dielectric condenser, which is connected in series with the aerial circuit has been dealt with.*

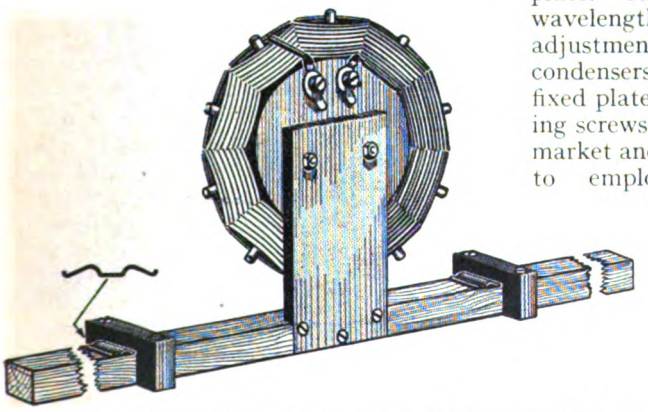
The most suitable value of capacity will depend upon the size of aerial to which the set is connected though 0·000025 mfds. will be found generally suitable.

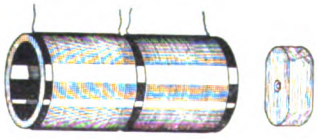
The variable tuning condensers should possess a low zero capacity and preferably be of the square law type. Tuning condensers are invariably of the air dielectric type nowadays, though unfortunately many of the patterns possessing metal end plates have thin ebonite bushes separating the fixed and moving plates and it is across this dense dielectric that most of the electrostatic strain takes place. The resulting losses on very short wavelengths may be appreciable. Vernier adjustment is desirable on both tuning condensers. Variable condensers in which the fixed plates were not connected to the securing screws could not be found on the British market and consequently it became necessary to employ the Sterling square law



A section of the front panel and platform for mounting the two 0·000025 mfds. Sterling condensers. It is 3 ins. wide by 7 ins. long, and the face is 1⅜ ins. above the base. The copper foil screen is held in position by the top and bottom battens. The base projects at the end by an amount equal to the thickness of the ends of the cover box which drops over. A slot in the top of the cover box leaves the terminal and tapping panel flush.

* Page 36. *Wireless World*, Oct. 8th, 1924.





The reaction coil is operated by a mahogany rod ¼ in. by ¼ in., and carried on an ebonite support 1¾ ins. by 3½ ins. by 3/16 ins. The rod should be a loose fit beneath the two ebonite brackets and clamped down firmly by two pieces of bent bronze spring so that the coil will stand vertically. The former of the two choke coils in the telephone leads is 3 ins. long by 1½ ins. in diameter, and is wound with No. 38 D.S.C.

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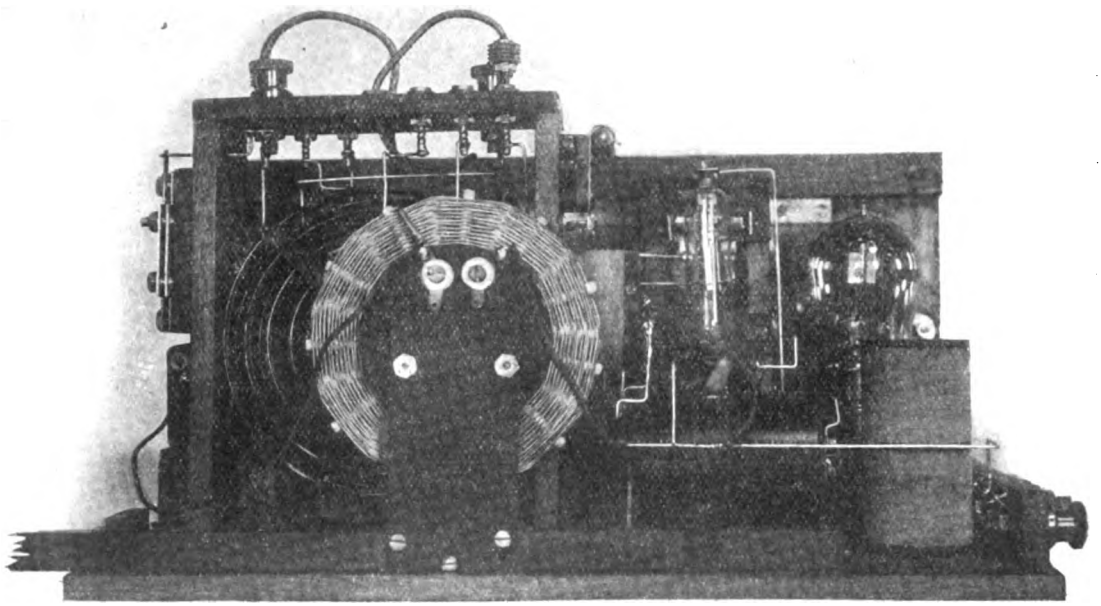

View of the back of the instrument showing the method of mounting the reaction coil. The choke coil in the detector valve plate circuit is 1¼ ins. in length by 1½ ins. in diameter and is wound with ¾ in. of No. 38 D.S.C. so as to possess low self-capacity. It can be seen attached to the side of the inductance frame with the grid condenser and leak just above it.

type supported by a wooden bracket and set a little way back off the panel.

The construction of the choke coils is given in the accompanying illustrations and some explanation may be needed for the fitting of the two chokes in the leads to the telephones, which is a new feature. In operation both the receiver and its batteries should stand upon porcelain insulators so that only one point of earthing exists and that is at the far end of the earth lead. If a counterpoise is used instead of an earth connection it becomes far more important that the set shall not be earthed through a high resistance or capacity path, for those acquainted with transmission know how important it is to eliminate extraneous earthing and to separately tune every path which is capable of forming part of the oscillatory circuit. Thus in insulating the set and its batteries from earth, provision must be made to feed the telephones through efficient chokes to avoid oscillation leakage.

The valve adopted is a V 24 working from a six-volt accumulator with a plate potential of about 70 volts, rectification being carried out by the usual grid condenser (0·00015 mfds.) and leak (2 megohms).

As the entire front of the instrument must be screened there is no need to construct it from high-class insulating material and in this instance the panel is made of ¼ in. mahogany (which can be purchased already planed) with vertical grain and backed with thin copper foil or tin plate.

The metal screen is connected by a short lead directly to the earth terminal of the instrument, as are also the spindle connections of the two variable condensers. Ormond filament resistances are employed and in attaching them to the panel the spindles become earthed and are made the negative side of the filament battery.

The remainder of the constructional details can be seen from the detailed diagrams and the writer has departed in this instance from giving the usual dimensional drawings as when making up a set of this sort some apparatus is certain to be ready to hand, thus necessitating modifications to any dimensions that might be given.

The set shown in the illustrations was

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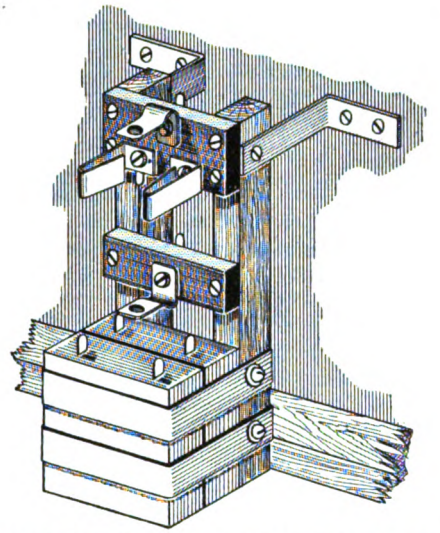
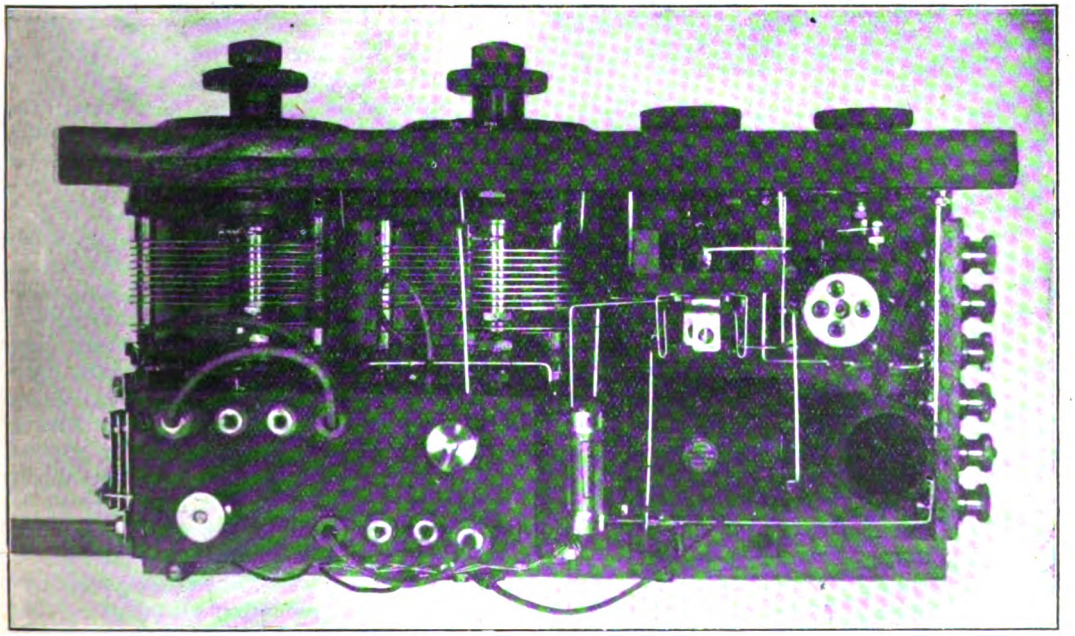
worked out to be compact and simple to make. Tapping of holes, which is sometimes a difficulty, is entirely avoided. The two valves, although of different types, are mounted up to come central with the windows, while the note magnifier valve presents its silvered side to the rear. The battery terminal strip is of wood, as the batteries are connected by short leads and separated by insulators from the table, while no great potentials requiring ebonite as an insulator exist between them. The aerial and earth terminals are of course on an ebonite panel above the inductance and thus connected by very short leads to the coils. The telephone terminals are set up on ebonite to prevent the head telephones, which are really at earth potential, from earthing the woodwork of the set. Wiring up is carried out with No. 18 tinned copper.

As to results, when connected up to a single wire aerial 75 feet in length including down lead, at the local wireless club (Hampstead and St. Pancras Radio Society), several American amateur stations were tuned in immediately, while **KDKA** came in on both the 100 and 65 metre waves (I am a little doubtful as to the exact value of the lower wavelength) at good strength and reasonably intelligible.



Details of simple wood bracket for mounting the V.24 valve and H.T. condensers. The vertical pieces are 5⅜ ins. by ½ in. by ⅜ in., and the height of the centre of the valve windows is 4⅛ in. from the bottom edge of the panel.



View from the top showing the relative positions of the components. The telephone terminals near the front of the instrument are inserted into ebonite bushes. The base is 6¾ ins. by 13½ ins. by ⅜ in. The front panel projects 1/16 in. over the base and the ends extend ⅜ in. and carry the terminal strip at one end.

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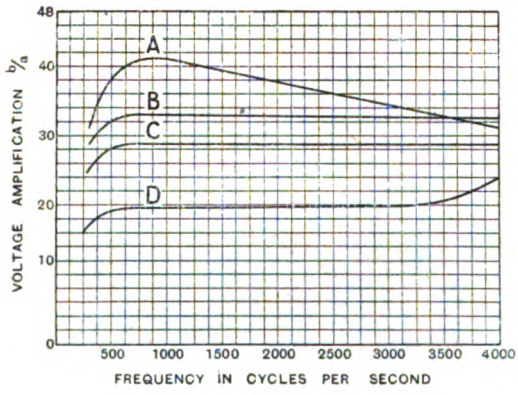
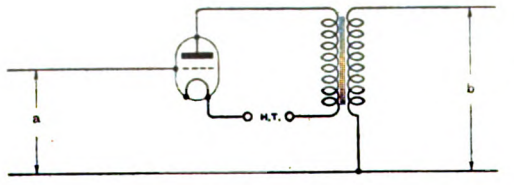
DISTORTIONLESS AMPLIFICATION.

THERE are three principal methods of speech frequency amplification, employing resistance capacity, choke capacity or transformer coupling.

It may quickly be shown that the first and second methods are inefficient from the point of view of the degree of amplification obtainable per stage compared with transformer coupling. On the other hand, it is much easier to obtain distortionless amplification when the resistance or choke capacity method of coupling is employed. This does not mean that it is not possible to obtain distortionless amplification with a transformer-coupled amplifier, as may be seen from the accompanying characteristic curves of the Marconiphone "Ideal" Transformer.





A, 4—1 *transformer with R valve, anode volts* 80, *filament volts* 4; $R = 40{,}000$ *ohms*, $m = 10$. *B*, 6—1 *transformer with L.S.* 5 *valve*; *anode volts* 160, *filament volts* 4·5; $R = 7{,}000$ *ohms*, $m = 5{\cdot}5$. *C*, 2·7—1 *transformer with R valve as above*. *D*, 4—1 *transformer with D.E.* 3 *valve*, *anode volts* 80, *filament volts* 3; $R = 16{,}500$ *ohms*, $m = 5$.

The difficulty has been to obtain suitably matched transformers and valves. It is difficult to design a good transformer to work well with a particular type of valve, and well-nigh impossible to design one which will give faithful amplification with any type of valve. Hence the accompanying amplification-frequency curves are of special interest.

The amplification per stage is defined as the ratio of the voltage at *b* to that applied at *a*, and is measured for constant applied voltages of different known frequencies. Curve *A* shows the voltage amplification per stage for various frequencies with a transformer having a ratio of 4 : 1 when connected to an "R" type valve having an impedance of 40,000 ohms, and an amplification factor of 10. The tests were made with a filament voltage of 4 volts, and an anode voltage of 80. Particulars of the other curves are given below the figure. It will be seen that the degree of amplification for constant input voltages of various frequencies varies only slightly. The largest amplification is obtained when the frequency is 1,000. At 4,000 cycles the amplification is about 25 per cent. lower. The "R" type valve is a high impedance valve. Hence better results are obtained with a transformer which has a high impedance primary winding, and consequently a low turn ratio.

The curve obtained with an "R" valve and a 2·7 to 1 transformer is marked *C*. It will be seen that the degree of amplification is uniform from 600 to 4,000 cycles, and slowly falls off at the lower frequencies. This is a remarkably good characteristic curve, and indicates that under correct operating conditions the reproduction should be practically perfect.

An amplification of 30 per stage is extraordinarily good, and it is important to notice that Ideal transformers are guaranteed to have an amplification curve at all frequencies within 5 per cent. of the examples shown when used with valves having the constants quoted. W. J.

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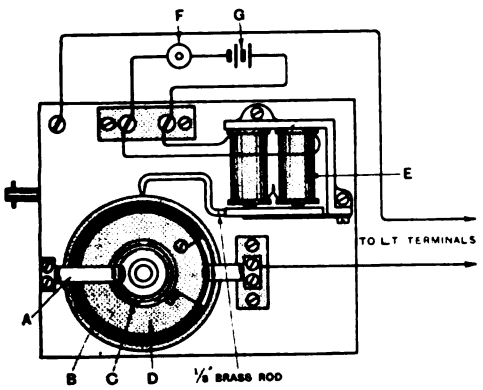
READERS' PRACTICAL IDEAS

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Novel Remote Control Device.

THE particular feature of this design is that the valve filaments are not subjected to the strain produced by suddenly switching on full current and provision is made to rotate a filament resistance so that



Remote filament control.

the filaments are brought slowly to full brightness. The parts used consist of an old gramophone motor to which is fitted the movement of an electric bell. The usual form of filament resistance is attached to the main spindle by means of a fibre disc. This disc is notched at the side in two places so that the brass arm which is actuated by the electric bell movement, will drop in at the correct "on" or "off" positions. When the bell push is pressed and quickly released, the armature of the bell moves upwards, allowing the motor to revolve and gradually lighting the valve filament. The edge of the brass extension of the bell armature will, of course, engage in the second notch, which will arrest the clockwork mechanism and leave the valve filament current correctly adjusted.

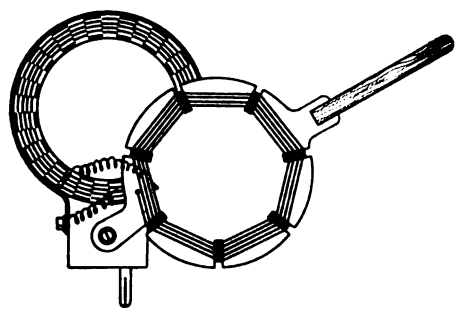
When it is desired to switch off the valve the push is operated for a brief interval and again the clockwork will revolve, being arrested when the brass arm engages in the second notch.

A number of switches can be connected in parallel and when the governor of the motor is correctly set, one wind will last for three or four months.

H. L. O.

Vernier Reaction Adjustment.

THE diagram shows a simple form of construction for reaction or vernier tuning to operate on the side of a plug-in type of coil. The coil former should not be constructed of cardboard as the extension used for attachment will be too weak, but thin ebonite might be employed, taking care not to cause a crack while cutting to shape. It is



Vernier tuning for plug-in coil.

a good tip when cutting thin ebonite to either warm the scissors or warm the ebonite itself, which will render it much less brittle.

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The former can, of course, be made from thin wood and the edges rounded where the wire passes through the slots.

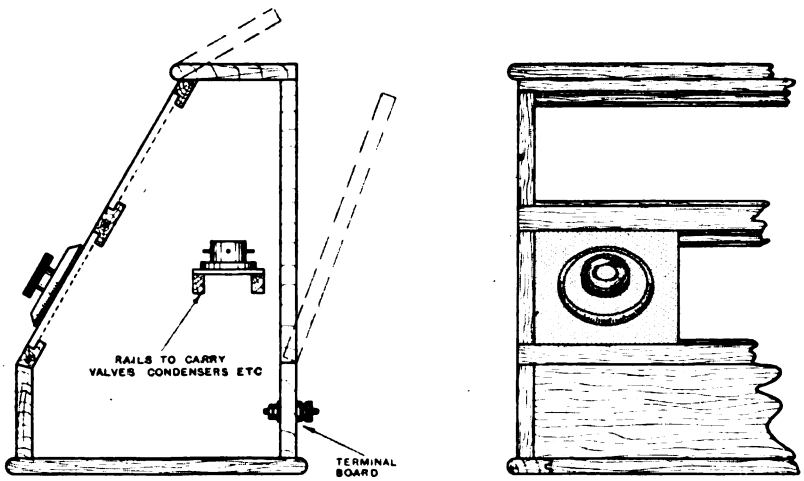
Instead of using this additional coil as a reaction coil, the winding may be connected in series with the winding of the plug-in coil, so as to form a variometer with the coil winding. This will be found a very useful method for providing critical tuning.

E. M.

Experimental Cabinet.

TO facilitate the rapid trying-out of different circuits each component is mounted on its own separate panel. Thus variable condensers, resistances, etc., can be mounted to occupy the lower section shown in the accompanying sectional view, whilst filament resistances, valve windows and switches can be mounted to occupy the upper space. The valve holders can, of course, be mounted to occupy a space inside the cabinet to conform to the usual practice. The actual constructional details of the cabinet may be followed and forms the basis of a good design for building experimental receiving sets.

R. W.



Cabinet design for experimental work.

Soldering Enamelled Wire.

THE enamelled surface used as insulation on copper wire can usually be removed by a scraping when only a single wire is being soldered. In the case of Litzendraht, however, which consists of very many strands of fine enamelled wire, it will be found very difficult to sufficiently remove the enamelled covering to permit of good soldering. When an attempt is made to scrape such wire it invariably happens that many of the strands become broken and the efficiency of stranded wire falls off very much when several of the strands are not picked up.

A good method to remove the enamelled covering consists of heating the wire in a bunsen flame until it is just red hot and then quickly immersing it in a small dish containing methylated spirits. It may be necessary to repeat the process several times. Prior to soldering it is dipped into a paste consisting of pure resin dissolved in methylated spirits and tinning is best effected by dipping the end of the wire into molten solder. When this process is being applied to Litzendraht wire it is advisable to bind up the fine strands with a piece of clean bare wire. This process of tinning can of course be applied to ordinary bare copper wires and will be found an easy method of cleaning the surface.

E. W. C.

Frayed Telephone Cords.

WHERE the tag connects to the flexible end of the telephone cord fraying usually takes place after a while and

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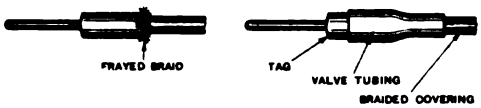
the frayed cord is only the forerunner of an intermittent telephone lead. To relieve the strain on the flexible wire at the point where it connects to the tag, a piece of indiarubber



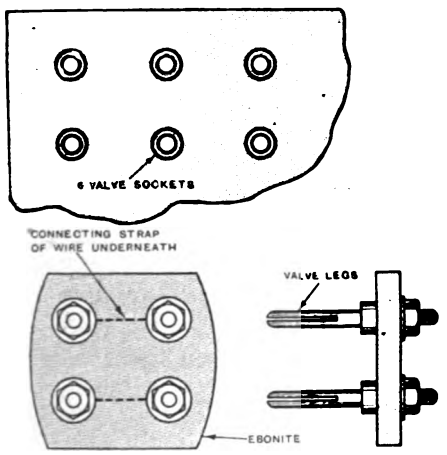
Telephone lead improvement.

tubing should be fixed over the end of the tag and passed some little way along the cord. This prevents the cord bending acutely at the junction and at the same time completely covers the frayed ends.

E. B. G.

A Useful Change-over Switch.

ALTHOUGH valve sockets were first introduced on the market for the construction of valve holders, it was soon realised that their utility went further and that they could be employed for the construction of plug-in connections. For this reason valve legs are now also obtainable and with these, built up on to a suitable small piece of ebonite, one can easily make up a good change-over switch, as shown in the accompanying drawing.



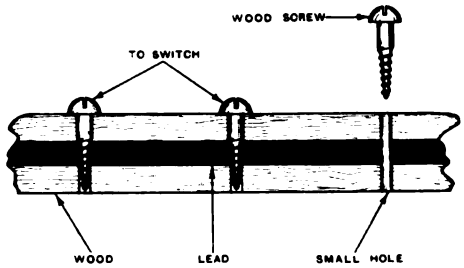
Valve legs and sockets make a useful change-over switch.

The ebonite piece which is to carry the valve legs should be made up first, and the greatest care should be taken to see that the holes are correctly located. Using this piece as a template, four holes may be put in the instrument panel and then transferring it across the remaining two, can be drilled through. By this means the valve legs will come into exact register with the valve sockets, which is very necessary if a good fit is to be obtained.

L. M.

Filament Resistance for Dull Emitters.

THE lead contained in pencils varies in resistance from 30 to 300 ohms. The soft " BB " pencils may be used as a filament resistance for dull emitters, while for higher resistance values, for use in potentiometers, the lead contained in " HH " pencils may be usefully employed.



Lead pencils as filament resistances for dull emitters.

The simplest method of making the required contacts at several points along the lead, consists of carefully drilling holes into the pencil and inserting screws, taking care if possible, either not to fracture the lead or at least, not to let it slide through the wood and out at the ends. For this reason the end screws should be inserted first and wires may be conveniently soldered to the heads of the screws. The screw heads should then be connected up to a multi-stud switch which is used in place of the ordinary filament resistance.

H. W. W.

Switching High Frequency Amplifying Circuits.

SEVERAL methods are now in common use for switching in and out of circuit, high frequency amplifiers. Avoiding switches, high frequency amplifiers can be taken out of circuit by merely transferring the aerial connection from the first valve grid to the grid of the second or detector valve. Referring to the accompanying diagram, A and B represent socket connections to which the

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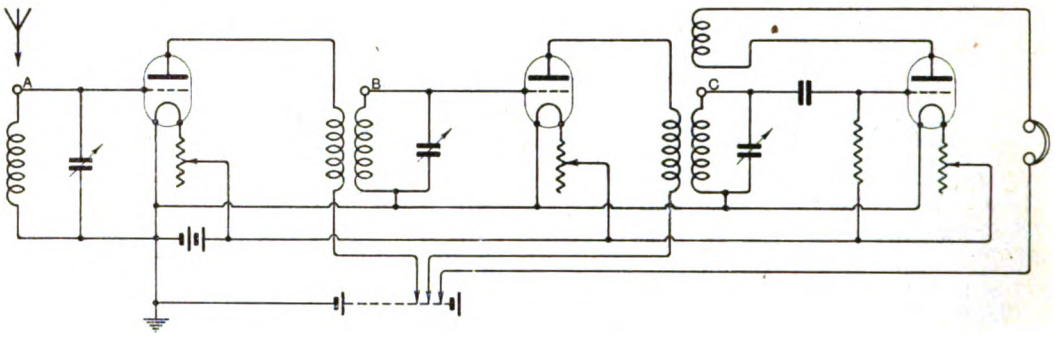


Circuit changing without switches.

aerial lead can be plugged. The H.F. transformers are constructed from plug-in coils and when the aerial plug is in the socket B, the primary of the H.F. transformer can be removed from the first valve plate circuit.

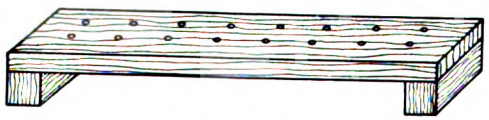
N. M.

Rack for Tuning Coils.

IF tuning coils are allowed to lie about the experimental bench they will rapidly become damaged, owing to their construction being somewhat frail, whilst one cannot quickly select a suitable coil.

A simple method of arranging them is to suitably drill a length of wood with holes having the same spacing as the pin or pin and socket. The coils can then be attached to the board by means of these holes and if they are arranged in order, any size coil can rapidly be selected.

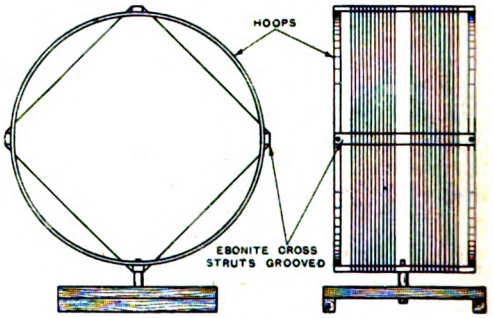
W. E. R. S.



Rack for tuning coils.

Wooden Hoop for making Frame Aerial.

TO avoid the necessity of using wooden cross supports in constructing a frame aerial, procure two wooden hoops of a diameter of 3 ft. or upwards. Four cross pieces made from strips of ebonite are screwed to the hoops to hold them together and provide the necessary support for the winding. These cross pieces may be slotted slightly in order to hold the wire in place and to act as a guide when putting on the turns.



Frame aerial from wooden hoops.

The lower cross piece should perhaps be a little wider to enable some convenient form of mounting to be attached.

L. M.

An H.F. Transformer Tip.

When constructing high frequency transformers with tightly coupled windings, it is a good plan when aiming at producing two windings of equal inductance to use cotton covered twin bell wire, such as is generally used in wiring house circuits.

Honeycomb lattice coils can quickly be made up with this wire. The ends are easily identified as the two wires are given distinctive markings. Although the wire is somewhat thick, the turns will hold securely together if wax impregnated.

J. L. B.

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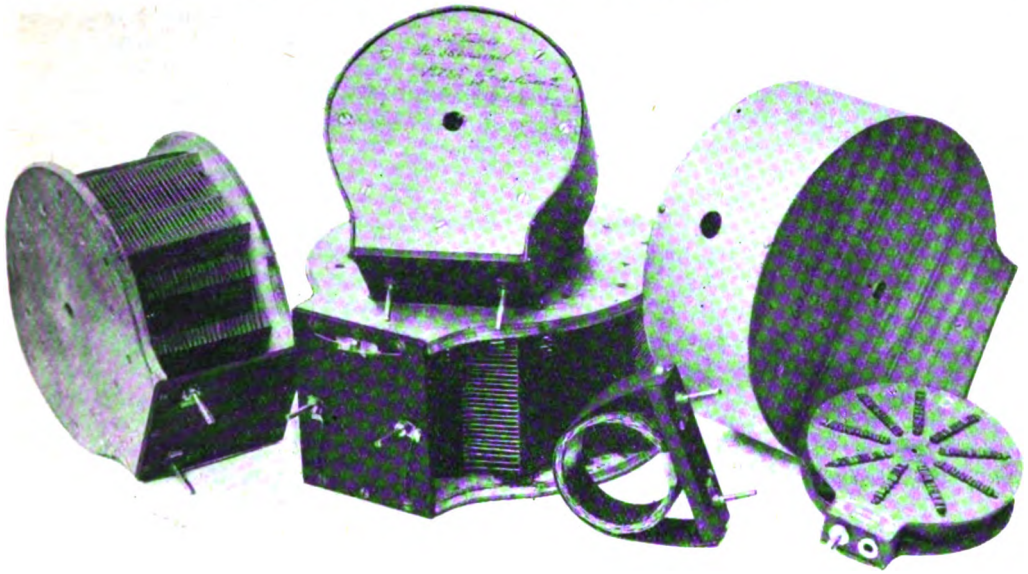

A group of plug-in coils with windings of low self-capacity.

NEW COILS OF HIGH EFFICIENCY.

A good deal of progress is being made by the amateur in the design of inductances of extreme efficiency. The problem of efficient design is not a simple one, and is governed from the theoretical standpoint by many considerations from which a compromise must be drawn, while the actual mechanical construction calls for considerable ingenuity if the desirable features which theory indicates are to be utilised to the full.

By J. H. Reeves, M.A.

CONSIDERABLE attention is being devoted to the design of tuning coils of extreme efficiency and efforts in this direction chiefly lie in the designing of inductances in which the turns are air-spaced.

The writer has constructed a number of tuning inductances having a minimum of dielectric material to support the turns and a feature of the designs employed is that he coils can be built up by one who is unskilled as an instrument maker and has only a few simple tools available.

In my article published in this journal (30th April, 1924) I pointed out that under conditions where there is ample margin of signal strength, that is within 15 miles or so of a broadcasting station, improved definition can be obtained by the use of fine wire coils in the tuning circuits. At the time opinions differed as to whether the improved results arose from increased ohmic resistance or from decreased distributed capacity, consequently I have wound a good many coils for the purpose of testing this comparison.

For example, a set of coils is made up using No. 22 wire, first with the turns touching and then with a clearance of 1, 2 and 3 diameters. Results indicated that the coil with turns touching was inferior and that spacing 2 was better than spacing 1, while spacing 3 was a slight improvement upon spacing 2.

I had previously found much the same result with inductances constructed with a considerably finer gauge of wire, hence I was led to the conclusion that in the design of coils it was more important to devote attention to reducing distributed

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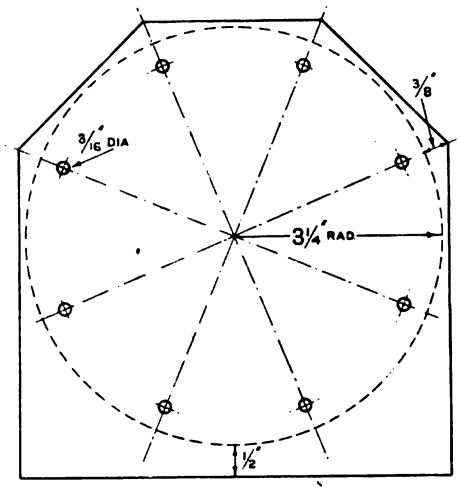
capacity to a minimum than to guard against losses due to resistance. Another feature which leads to inefficiency is the electrical losses in the material used to support the wire, and comparison was made between two coils both consisting of No. 38 S.W.G., one with a quadruple cotton covering and turns touching (spacing 1/40 in.) wound on a cardboard tube and another of enamel wire practically air-supported and wound to the same pitch.

The results obtained were distinctly in favour of the latter and hence the argument in favour of self-supporting coils constructed with stiff wire is strong. Unfortunately this involves in the case of the A.T.I., a coil of large dimensions, while in the case of closed circuits the tuning inductances are clumsily big.

On reference to a standard text book it will be found that for a given length of wire, that is for a given ohmic resistance of whatever gauge is selected, the most efficient coil produced for the diameter is 2·4 times the length. Combining this with the well-known Nagaoka's formula, there is a simple rule by which the dimensions for any required wavelength can be calculated.*

Turning now to the actual construction of inductances possessing low self-capacity, the group of coils shown in an accompanying illustration have been made up to comply with the considerations just dealt with. It is not proposed to deal in detail with the several varieties shown and reference will only be made to the coil shown on the left in the illustration on page 77 which is probably the easiest form to make up.



Setting out the positions for the bars.

The material required is :—

1. Two pieces of good ¼-in. fretwork, preferably 3-ply. I found some very good pieces on the scrap heap of a motor body builder, and in any case suitable wood can easily be obtained at a very reasonable price.

---

*THE DESIGN OF SINGLE LAYER CYLINDRICAL COILS.

The best proportion is when diameter = length × 2·4.

Nagaoka's formula : $L = \pi^2 D^2 n^2 lk$.

where L = the inductance.
D = the diameter.
l = the length.
n = the number of turns per 1 cm.
k is a coefficient depending on the ratio D/l

Now if D/l is to be kept constant at 2·4, k is constant, and if the coil is to be wound with wire of diameter d and pitch m then $n = \frac{1}{md}$

therefore substituting

$$L = \text{a constant} \times \frac{D^3}{m^2 d^2}$$

The minimum wavelength of a coil in a tuned closed circuit is given by

$$\lambda = \text{a constant} \times \sqrt{L \times C_0}$$

where C_0 is the capacity introduced by the panel, valve, coil mount, etc. when the tuning condenser is set at 0°

Squaring this last equation and substituting for L

$$\lambda^2 \alpha \frac{D^3}{m^2 d^2}$$

i.e., $D \alpha [\lambda m d]^{\frac{2}{3}}$.

Example :

On a certain panel, a coil 4 ins. diameter of 60 turns No. 38, pitch 4 diameters (approx. 1/40 in.) was found to tune to 340 metres. What must be the diameter of a similarly proportioned coil wound with No. 22, pitch 3, to tune to 200 metres.

Here $\frac{D}{4} = \left[\frac{200 \times 3 \times \cdot 028}{340 \times 4 \times \cdot 006}\right]^{\frac{2}{3}}$

D = a little over 6 ins.
l = 2·6 ins.

Total turns 31 or 32 approximately.

A similar coil, No. 20, pitch 4 to tune to 340 m. works out to require

D = about 13 ins.
l = 5½ ins.
turns 38.

The large two layer coil in the centre of the group on the previous page was the compromise. This is the closed circuit inductance for tuning to **2 LO** and requires nearly 20° of a ·00045 condenser.

What would be the size of a No. 18, pitch 4 to form even the A.T.I. for a super-crystal set to receive **5 XX** is best left to the imagination.

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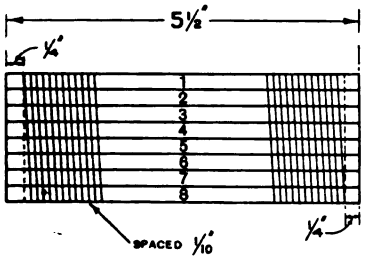
2. Two 3-ft. lengths of ½-in. square strip mahogany. One 3-ft. length of 3/16 in. round wood strip. These can be bought for a few pence from Messrs. Hobbies, the well-known dealers in fretwork materials. It will not be difficult, of course, to plane up suitable wood to size.
3. A strip wood cutting table to facilitate accurate cutting of the wood to the required length. Messrs. Hobbies supply a suitable table with length gauge for about 4s.

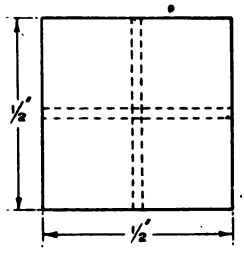
The coil to be constructed is 6½ ins. across diagonals, the length of the bars being 5½ ins., and is wound with 50 turns spaced 10 to 1 in., which is about the largest number of turns which can conveniently be wound with



Marking out the bars for the position of the turns.

No. 20 S.W.G. The diameter of this wire is not quite 3/16 in., and by winding 10 turns to the inch there is a clear spacing of approximately two diameters or, as I would prefer to call it, a coil of "Pitch 3."

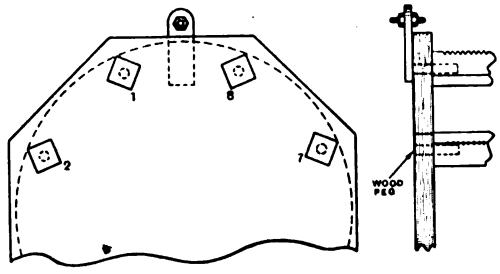
To construct the end pieces, describe a circle 3¼ ins. radius, divide the circumference into eight equal parts and draw the four diameters. Next cut out points inside and outside the circumference and along each radius at distances of ⅜ in. By joining up six of the points externally to the circumference, the five sides of an octagon will be produced. The ends of this line are extended so that when joined across on a line at right angles the joining line is about ½ in. below the circumference of the circle. Drill a small centre hole large enough to pass a ½-in. No. 4 wood screw and secure this marked-out piece of board to a second piece. Now clamp in a vice and drill through both boards as squarely as possible one of the 3/16 in. holes which is marked out at ⅜ in. from the circumference inside the circle. Plug into this hole a piece of 3/16 in. round strip. Now drill the hole the other end of this diameter, plug as before and then proceed to mark the remainder of the holes. With the two pieces



Simple method of finding the centre of ends of the bars.

of wood secured together cut to shape, thus making two end pieces with holes exactly corresponding. The sides may be finished by filing and care must be taken to ensure that the side which is to form the base is at exact right angles to the adjoining edges before separating the two pieces marked "Front" and "Back" so that their correct relative positions will not be changed when finally assembled. Finish by rubbing down with glasspaper.

The centre holes should be enlarged so as to pass a metal rod 12 or more inches in length and about ½ in. in diameter. This is for use when winding.



Details for setting up the end pieces.

The pieces which are to form the bars to give support to the wire must be accurately and squarely cut to length. Eight pieces 5½ ins. in length will be needed. Now place all the eight pieces side by side and number them 1 to 8.

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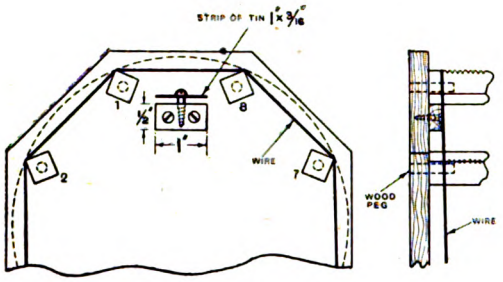
As the turns are to be spaced 10 to the inch, the upper edge of piece No. 1 and the upper edge of piece No. 8 should be divided

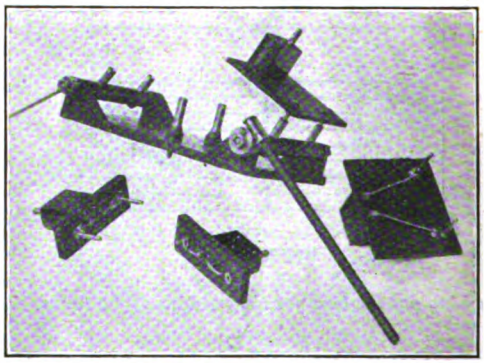


Another form of terminal piece is shown here, for securely holding the end of the wire.

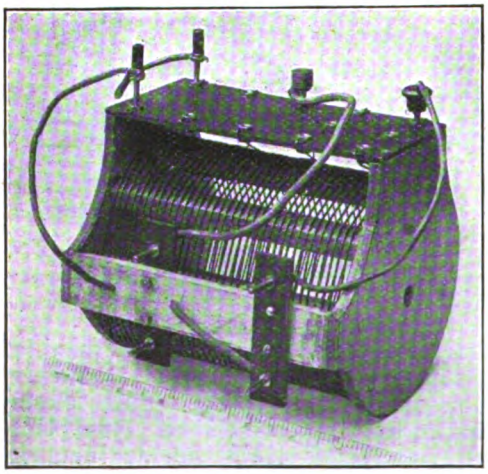
into 1/10 in. and lines should be ruled across so as to divide pieces 2, 3, 4, 5, 6 and 7. These lines are not drawn straight across, of course, but connect the dividing points of the piece No. 1 with the dividing points of piece No. 8, one further along. At each end a space should be removed of ¼ in. as it is not intended to wind the turns close up to the ends of the bars. The next step is to locate the centres in the ends of these pieces, which is easily done by pressing the ends against a straight piece of wood a little under ¼ in. in thickness and ruling lines across. The pieces should be rotated so that four lines in all are drawn on each end in each piece. In turn place each piece end up in a vice, centre the punch between the four lines and drill as square as possible 16 holes about ½ in. deep with a 3/16 drill. A good plan is to drill only the alternate bars to full size right away, making slightly smaller holes in the remaining pieces and drilling them out to size when temporarily assembled in position, using those pieces with 3/16 in. holes to facilitate a preliminary assembly. When finally assembling, the 3/16 in. pegs may be slightly pointed and driven in with glue or seccotine. The ends can now be cleaned off and rubbed down.

Terminal pieces must be made up and fixed in position to secure the end of the wire and the precise design is left to the reader.

Before proceeding to wiring, it is advisable to make small indentations into the bars



Coil holder with greater spacing between the pins than is usually provided. Several adapters are shown for using the holder with standard coils.



A useful tapped coil for short wave work.

at the points where the wire rests, after which the whole of the wood should be treated with two or three coats of good shellac.

As the inductances of the coil will probably be varied by means of a tapping clip, tinned wire must be used, and No. 16 is a satisfactory gauge, giving good strength mechanically.

The former should be mounted on the ½-in. rod, held securely in the vice when proceeding to wiring, but the job cannot be done without assistance. One operator may rotate the former and guide the wire while another applies the necessary tension, a third strengthening the wire before it approaches the winding. Very considerable tension can thus be given.

For smaller coils, suitable for plug-in purposes for a short wave heterodyne and the

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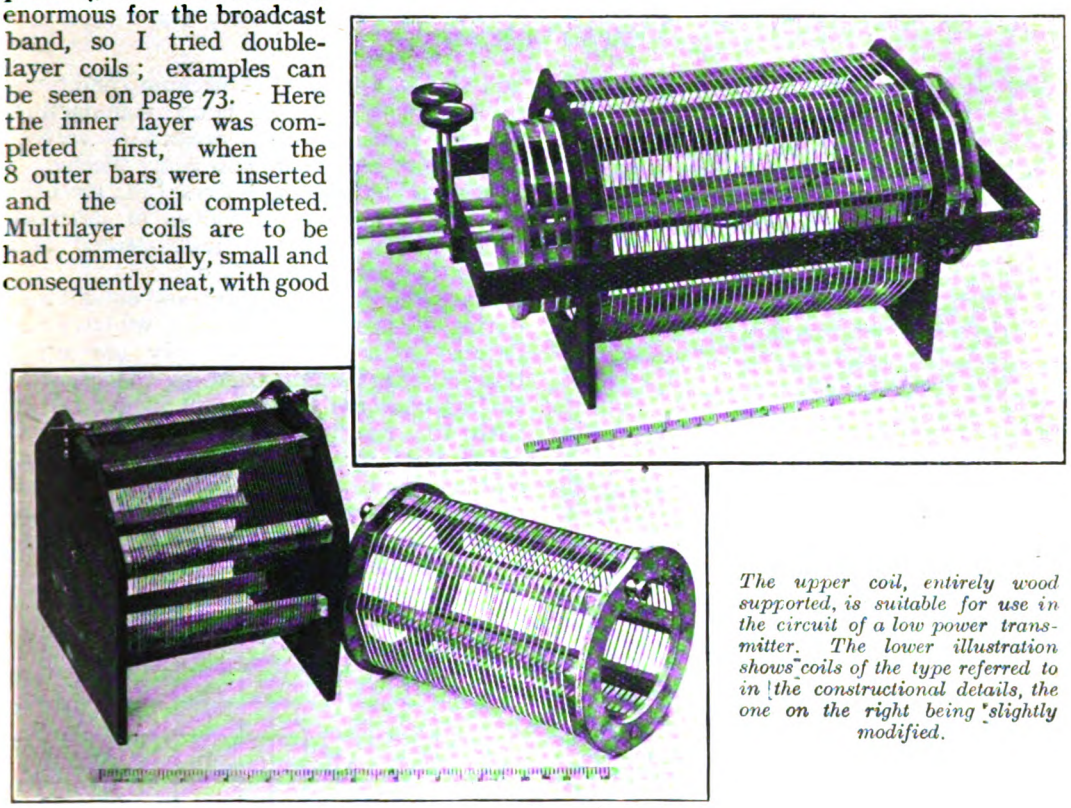
like I have tried other forms, several being based on empty reels from which fishing lines have been taken, but on the whole the method described in this article has proved more satisfactory. For an anode coil No. 20, with pitch 3 and more so with pitch 4, the size becomes enormous for the broadcast band, so I tried double-layer coils; examples can be seen on page 73. Here the inner layer was completed first, when the 8 outer bars were inserted and the coil completed. Multilayer coils are to be had commercially, small and consequently neat, with good spacing between both turns and layers. With these the inner layers must of necessity be comparatively inefficient, while the wire cannot approach even No. 22. Yet on test, using the adaptors shown on page 76, some of these have shown up most remarkably well even against the best known makes. This only confirms the view that it is the spacing and not the low ohmic resistance which is the desirable feature.

It is a pity that the present type of coil mount has been standardised (more or less so because mounts differ) with so small a spacing between plugs and sockets. For short wave work a wider spacing on plug-in coils seems highly desirable and I hope that when this comes it will be the 2-in. standard recently advocated in this journal. Those shown in the illustrations on page 73 are thus mounted and a triple mount can be made to look as neat as the present style. The one shown was made large to carry my very big coils; adaptors are shown to carry the present standard mount, also one by which the 2-in. mount can be used on present-day sets.



The upper coil, entirely wood supported, is suitable for use in the circuit of a low power transmitter. The lower illustration shows coils of the type referred to in the constructional details, the one on the right being slightly modified.

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VALVE TESTS.

REPAIRED VALVES.

Readers will look to this report with much interest, as considerable doubt exists as to the success with which a valve can be re-filamented. The repairs to the valves described below were carried out by Messrs. The Midland Valves, Ltd.

GENERALLY speaking, the life of a valve is determined by its filament, which means that a filament burn-out, either accidental or due to old age, is responsible for the greatest number of valve casualties.

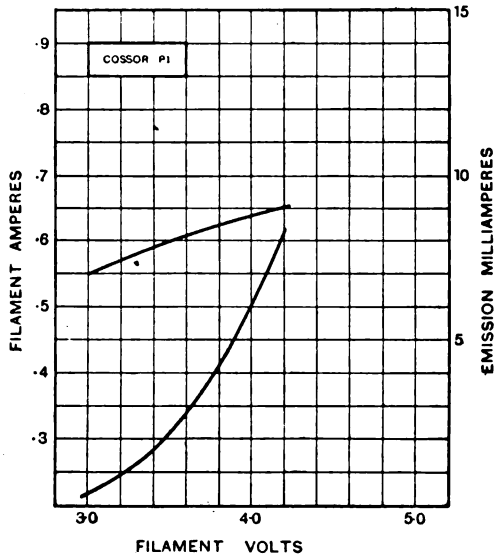

Fig. 1. Filament characteristics of a repaired Cossor valve, Type P1.

A good hard valve maintains its vacuum to the last, and if one were to go through the unserviceable valves which lumber the experimenters' shelves, "no filament" would be the result usually found.

Soon after valves became universally used among amateurs, certain firms gave their attention to repairing and re-filamenting valves, but our experience of their early efforts was not particularly satisfactory.

The vacuum was, for the most part, poor, and the filaments so different in their performance that it was almost impossible to run several repaired valves in parallel with a single filament control. Due probably to improved methods, better machinery, and the knowledge that vacuum conditions ordinarily obtaining in lamp manufacture are not sufficient when applied to valves, satisfactory repairs are now being effected.

Messrs. The Midland Valves, Ltd., recently sent us a number of valves of different types which they had re-filamented and which they asked us to try out.

Since the grid and plate are not altered during the process of repairing, we have not deemed it necessary to apply our usual tests for magnification and impedance, etc., as this concerns the original maker rather than the repairer, but we have applied strict tests for filament current, emission and vacuum, and in addition we have plotted grid-volts plate-current curves for some of the valves.

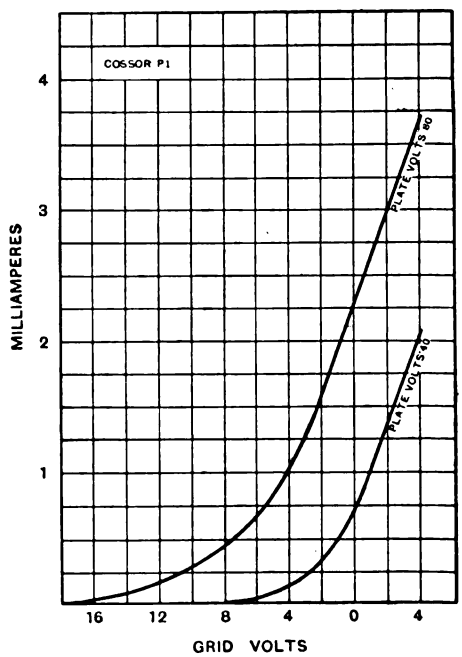

Fig. 2. Grid-volts, plate-current curves of repaired Cossor valve.

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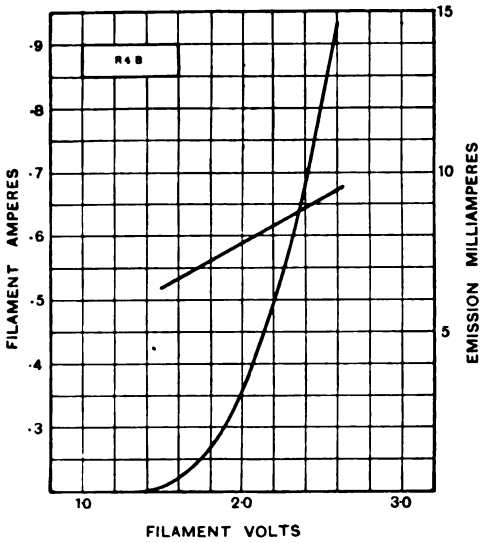

Fig. 3. Filament characteristics of the repaired R.4B. valve. Showing that a liberal emission is obtained at a filament voltage of 2·2.

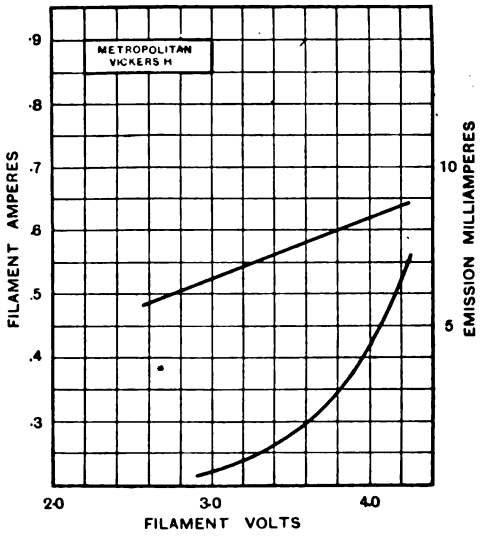

Fig. 5. Repaired Metropolitan-Vickers H type valve. The new filament here runs on 4 volts.

The types submitted were particularly varied and ranged from a small receiving valve to a 40-watt transmitter.

Figs. 1 and 2 refer to a Cossor P.1 valve, the maker's rating of which is 3·5 to 4·0 filament volts. At this latter potential the repaired filament gives an emission of 6 milliamperes with a current of 0·64 amperes. The filament is, however, apparently slightly longer than the original, which assumption is confirmed by the curves of Fig. 2, where the anode current is seen to extend

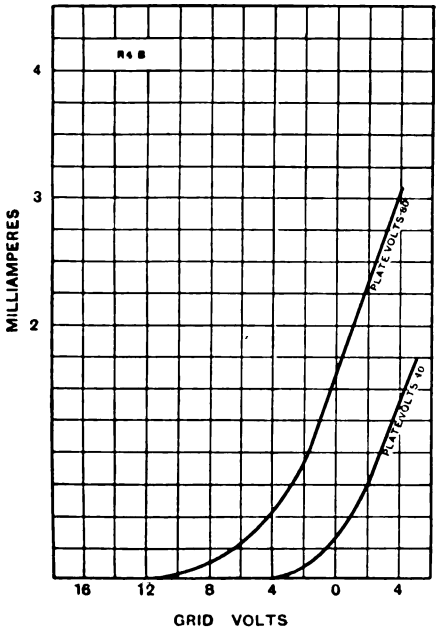

Fig. 4. Repaired R.4B., grid-volts, plate-current curves.

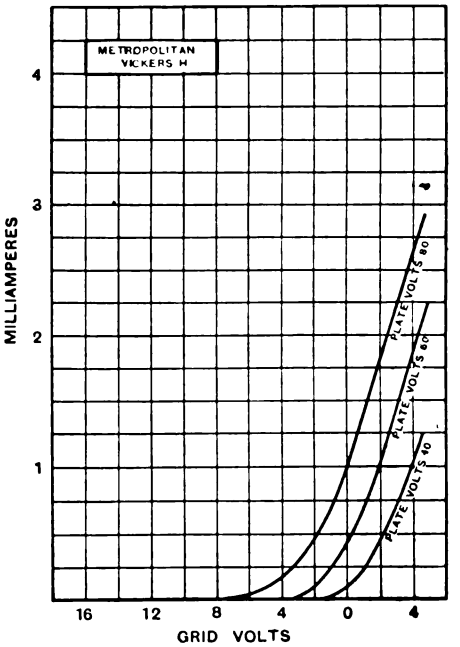

Fig. 6. Plate-current, grid-volts curves of the repaired H valve.

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over a long range of negative grid voltage. The valve is well exhausted.

Figs. 3 and 4 show the results obtained on an R.4B. type valve, and an emission of 6 milliamperes is obtained at a filament voltage of 2·2, rising to 13 milliamperes at 2·5 volts. The maker's rating for this valve is 3·8 volts, so that a totally different filament has been substituted in this case. Here again the vacuum is quite good.

Figs. 5 and 6 are taken on a repaired Metropolitan Vickers type "H." In this case we have the very liberal emission of 8·2 milliamperes at a filament potential of 4, and a good steady vacuum is reflected by the curves of Fig. 6.

The filament characteristics of a B.T.H. "A.T.40" valve are given in Fig. 7. This valve normally operates with a filament voltage of 7, the current and emission of the repaired sample being 0·81 ampere and 33 milliamperes respectively.

This type of valve normally operates with from 600 to 1,000 volts plate potential, and a vacuum test at the former voltage showed the pumping to have been well carried out.

The other valve submitted to us was a French "R" type. This gave a violent blue glow immediately it was put in circuit, and it was therefore useless to test further.

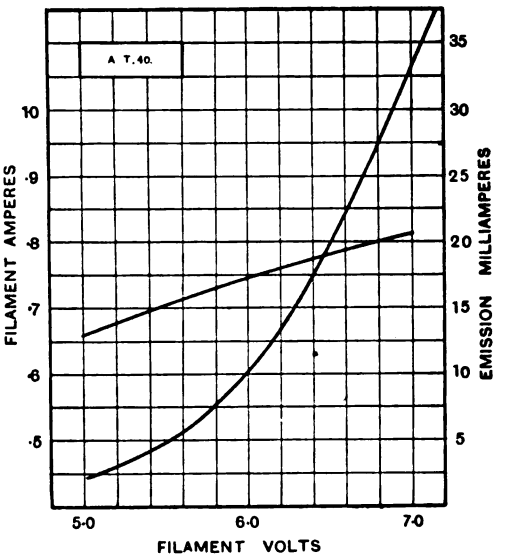

Fig. 7. The filament characteristics of a repaired transmitting valve, the A.T.40.

With the exception of the last mentioned valve, the submitted samples are capable of giving excellent service.

AN EASILY CONSTRUCTED VARIOMETER.

Many receiving sets of limited wavelength range employ variometer tuning. The instrument described here is easy to make up and efficiency is not sacrificed in simplifying the design.

By H. J. CLARKE.

THE variometer to be described is easily constructed at a comparatively low cost. It has an advantage over certain types of variometers, such as those where a ball revolves in a cylindrical tube, as the moving and stationary windings are closer together, thus giving a greater inductance change. The material required is:—

1 piece of ebonite tube 3 ins. long, outside diameter 3 ins, wall thickness $\frac{1}{8}$ in.

1 piece of ebonite tube 4 ins. long, outside diameter $3\frac{1}{4}$ ins., wall thickness $\frac{1}{8}$ in.

16 No. 6 B.A. countersunk head screws $\frac{3}{4}$ in. long.

6 ins. No. 2 B.A. threaded rod.

4 No. 2 B.A. lock nuts and a few No. 2 B.A. washers.

1 piece of ebonite $3\frac{1}{2}$ ins by 3 ins. by $\frac{3}{8}$ in.

$\frac{1}{4}$ lb. No. 26 D.C.C. wire.

First construct the rotor by cutting the smaller diameter ebonite tube to exactly $2\frac{1}{2}$ ins. long, taking care that the ends are square and the edges smooth. The spindles are secured to this tube by means of two ebonite battens $\frac{5}{8}$ in. wide, cut in

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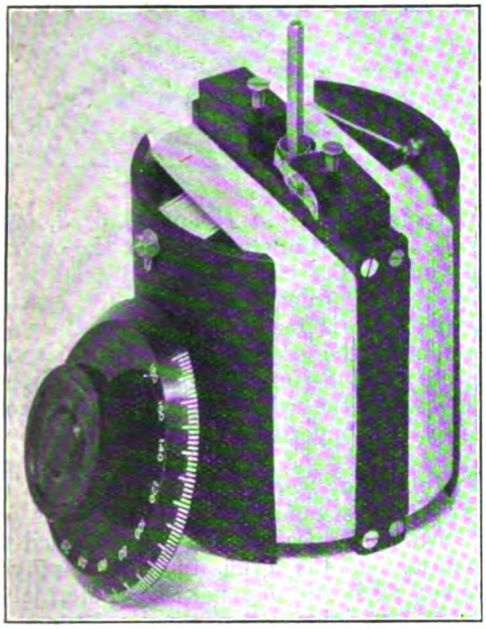
length to fit inside each end and screwed to the tube.

After the two battens have been fixed in



The finished variometer. Its "clean" design and robust construction are readily apparent.

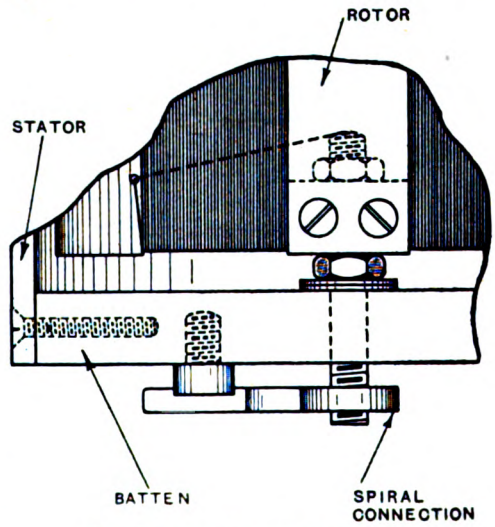
position cut grooves on either sides of them $\frac{3}{4}$ ins. wide, and just sufficiently deep to take the wire. The outside edges of these grooves should be slightly rounded. Remove the battens and screw into a centre tapped hole the threaded rod, and lock by a nut on either side of the batten. Two small holes must be drilled into the sides of the ebonite tube in the positions shown. The end of the wire should be passed through one of these holes and soldered to the inner end of one of the spindles. Replacing the batten the winding can now be commenced, starting from the outer edge of the groove and winding towards the centre. When completed fasten the wire temporarily round the spindle and cut off with a length of wire to spare. Now wind the second groove in a similar manner. The two inside ends of the windings are soldered together and pushed home in a saw-cut in the batten. Care must be taken that the windings are in the same direction.

The stator, that is the larger outside winding, can now be constructed from the $3\frac{1}{2}$ in. diameter tube. It is similar in design to the rotor, but differs in length, being $3\frac{5}{8}$ ins. long, and the grooves are made $\frac{3}{8}$ in. deep, while the battens, of course, are longer, being the same length as the inside diameter of this tube. The rotor, when completed, is arranged in position inside the stator and carefully adjusted between the battens. Should there be any play, pack each spindle with a washer or two.

When correctly set up, wind the stator in a similar fashion to the rotor, soldering the ends of the wire previously to the screws, which can be seen in the illustration in the sides of this tube.

The spiral connections are cut from thin strip brass, and are $\frac{1}{8}$ in. wide, and call for no special comment, only that one connection is soldered to a suitable brass standard, the one used being made from a small length of condenser spindle. The other spiral connection is screwed into one of the spacing pieces. The spacing pieces, used for attaching the instrument to the panel, are made from ebonite $1\frac{1}{8}$ in. by $\frac{5}{8}$ in. by $\frac{3}{8}$ in., with a 4 B.A. clear hole.

The writer has found this variometer to give very satisfactory results, with a liberal tuning range. The windings can be connected either in series or parallel by means



Details for setting up the spindles.

of a two-position double throw switch, or the windings bridged with a suitable fixed condenser.

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PATENTS AND ABSTRACTS

A Receiver which Employs Reaction but Cannot Excite the Aerial.

In earlier numbers of this journal we have described many methods of arranging a circuit which will not radiate locally generated oscillations. Another arrangement* is shown in Fig. 1. It will be seen that the

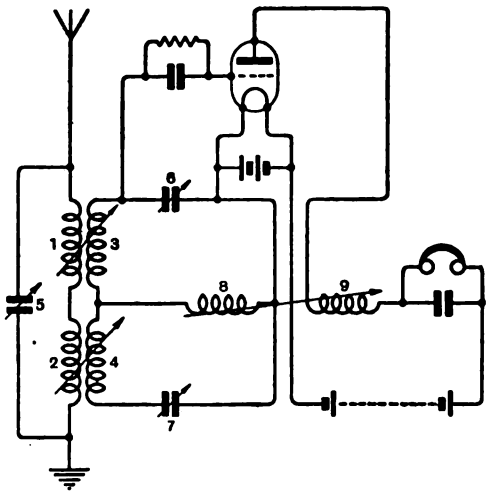

Fig. 1. An arrangement of circuits for preventing locally generated oscillations exciting the aerial.

aerial circuit contains two coils, 1, 2, which are coupled to coils 3, 4 respectively. Condenser 5 tunes the aerial circuit, and condensers 6,7, which are mechanically connected, tune the secondary circuit. A coil 8 is included in the wire which connects the centre point of coils 3, 4, and is coupled to the reaction coil 9.

When a signal is being received from the aerial the secondary circuit will respond, the currents in the neutral wire and inductance coil 8 being equal and opposite. If the reaction coil is coupled to coil 8, the signal currents flowing in circuit 3, 6, 8, tend to be increased in strength, but the currents flowing in the circuit 4, 7, 8 tend to be reduced in strength. Should the reaction coupling be increased so far that the valve oscillates, the oscillations will not appear in the aerial because the effect of the currents flowing in the windings 3, 4, are exactly equal and opposite.

*British Patent No. 220,765, by N. P. Hinton and Metropolitan-Vickers Electrical Co., Ltd.

A Method of Reducing Distortion.

In receivers employing valves it is well known that means must be provided for maintaining the grids of the amplifying valves at a suitable negative potential in order to minimise distortion. A common method is to take advantage of the fall in voltage over the filament resistance, or dry cells may be employed. In another method a resistance is connected between the filament circuit and the negative terminal of the anode battery and the fall in voltage over this resistance is utilised. It has been proposed* to add a choke coil and a con-

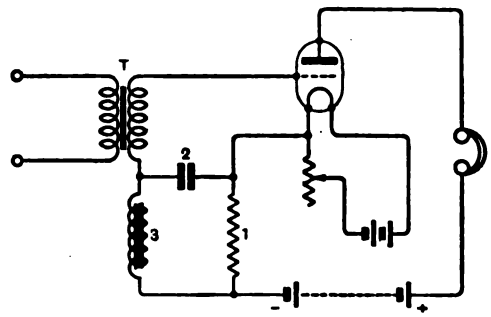

Fig. 2. A method of arranging the circuit of an amplifier to obtain a suitable operating (negative) grid potential.

denser to the circuit containing a resistance in the anode battery circuit in the manner

*British Patent No. 220,727, by E. A. Graham and W. J. Rickets.

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shown in Fig. 2. The resistance 1 is connected between the filament and the negative terminal of the anode battery. T is an intervalve transformer whose secondary winding is connected to the grid of the valve and to the filament *via* the condenser 2. A choke coil 3 is connected between the lower end of the secondary winding and negative of anode battery. If necessary the resistance 1 may be shunted by a condenser.

Wireless Valve Transmitters.*

THE DESIGN AND OPERATION OF SMALL POWER APPARATUS.

By W. James.

This is the first and only practical book on transmitting. The subject is thoroughly dealt with from a practical standpoint in order that the reader may be able to design and operate his own transmitter. All transmitters of interest to the amateur are described in detail.

There are 270 pages which are illustrated with 210 photographs and diagrams. The brief contents of chapters below give an idea of the wide range covered by this most useful book.

1. **Electrical Principles.**

2. **Inductance Coils and Condensers.** Design and construction of fixed and variable condensers. Design of tuning coils. The construction of tuning coils and chokes for transmitters.

3. **Alternating Current Circuits.** A.C. circuits containing resistance, capacity and inductance. Series resonance effects. Parallel resonance. Variometers.

4. **The Supply of Power.** Dry cells. Accumulators. Buzzer transformer unit. Adnil vibrator. Interrupter drum and transformer unit. The voltage raiser. Use of D.C. and A.C. mains. D.C. motors and generators. Motor generators. The dynamotor. The rotary converter. The design of transformers, choke coils and filters.

5. **Rectifiers.** Chemical rectifiers. Rectifiers for accumulator charging and for anode circuit supply. The Tantalum rectifier. Mechanical rectifiers. Mercury arc rectifiers.

6. **Valve Rectifiers.** Half and full wave, single and polyphase rectification. The supply of power for filament circuits. A commercial rectifier unit. The S tube rectifier.

7. **Microphones and Speech Amplifiers.** The valve as an amplifier. Transformer, choke and resistance coupled amplifiers. The microphone transmitter. Speech amplifiers. The double-button microphone. The Marconi-Sykes transmitter. The electro-magnetic transmitter. The condenser transmitter.

8. **The Three-electrode Valve as an Oscillator.** The three-electrode valve as a means of converting D.C. into A.C. The valve as a self-excited generator of oscillations. The Hartley circuit. The Colpitts circuit. The Meissner circuit. The modified Meissner circuit. The tuned anode circuit. The master oscillator circuit. Methods of increasing the output. Protection. The use of a valve as a grid leak. The series valve. Keying the circuit. Back loading. Particulars of transmitting valves.

9. **Modulated Waves and Wireless Telephony.** Transmitter with A.C. supply to the anode. Half-wave self rectification. Full-wave self rectification. Transmitter employing interrupted H.T. Modulated waves. Interference from modulated waves. Effect of modulation. Modulation by absorption. Modulation by shunting the aerial. Grid circuit modulation. Use of valve in grid circuit. Modulation by varying the anode voltage. A valve in series with anode supply. The choke control or constant current system of modulation. Choke control transmitters. Adjusting the transmitter. Van der Bill's system of modulation. Choke control of master oscillator transmitter. A commercial transmitter. Buzzer modulation. Choice of valves and anode voltage.

10. **Miscellaneous Notes and Measurements.** Measurement of inductance. An inductance bridge. Measurement of capacity. A capacity bridge. Moving coil voltmeters and ammeters. Hot wire ammeters. Aerials. Measurement of capacity, resistance and inductance of an aerial. Dummy aerials. Wavemeters. Oscillating crystals. Notes on inductance coils and condensers.

* Published by the Wireless Press, Ltd., 12 and 13 Henrietta St., London. Price 9s.

CORRESPONDENCE

Crystal Reception.

To the Editor of The Wireless World and Radio Review.

Sir,—With reference to Mr. Steuart's criticism of the rigid "catwhisker," it should be noted that the type he recommends, viz., a spiral of very fine wire, while quite efficient for very weak signals, is by no means efficient for the strong reception enjoyed by probably 90 per cent. of B.B.C. listeners.

Under these conditions the fine springy spiral intensifies microphonic action (with absorption of energy in vibrations of the wire) and when the signals are very strong, produces distortion. It is also more subject to mechanical shocks than a rigid type.

In making a rigid catwhisker a piece of No. 26 wire may be flattened out at the end to the requisite degree of thinness, so that the resulting "spear-point" cut from this has a point very much finer than the average spiral type of "catwhisker." With a "spear-point" catwhisker made in this way three different contacts may be employed—

(1) The very fine point.
(2) The knife-like edge of the spear.
(3) The flat side of the spear-point.

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In this way the area of contact with the crystal may be varied to suit the signal strength.

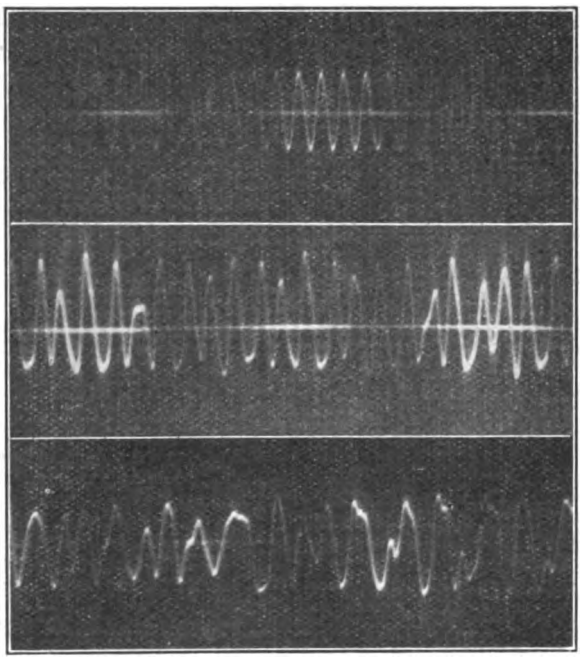
I use gold wire, gilt-phosphor-bronze and copper tipped with platinum.

I maintain strongly that, while it is essential to vary the area of contact and the resistance of the contact at the point, the most efficient crystal detector must be rigid, containing no members liable to vibrations of audible frequency.

I was interested to read Mr. Steuart's suggestion that maximum current strength may not coincide with maximum signal strength. From numerous experiments with a large number of crystals I have definite evidence that the volume of rectified current is by no means a measure of signal strength in many cases. For example, on the local B.B.C. station I get on the average 2 milliamps from a good synthetic galena and very loud reception. With another crystal I get the same current as measured by the galvanometer but very feeble reception, while with a third crystal I get reception only slightly inferior to the galena with only 0·15 m.a. The probable explanation of this phenomenon is that only a fraction of the rectified current consists of frequencies affecting the telephone diaphragm for the production of sound, and that this may vary with different crystals. A variation of this kind can be explained only on the basis of an electronic theory of rectification.

James Strachan.

Aberdeen.



Oscillograph curves of: (*Top*) *the tuning note from* **2 LO**; (*middle*) *the note of a saxophone*; *and* (*bottom*) *the note of a ukalele.*

Wave Form in Loud Speaker Circuits.

To the Editor of The Wireless World and Radio Review.

Sir,—The accompanying oscillographs were taken in a loud speaker circuit (120 ohms) between the telephone transformer and the loud speaker itself.

The circuit was fed through a L.S. 5 power valve —250 volts anode voltage, and the curves taken on a Duddell oscillograph directly in circuit.

The top curve represents the tuning note of **2 LO**, 1,000 complete cycles per second. The middle curve the note of a saxophone, approximately 900 cycles per second. The bottom curve the note of a ukalele (Hawaiian banjo), approximately 650 cycles per second.

As these represent current curves, they are rather interesting in comparison with the mechanically obtained records of sound waves now being published.

Mortimer A. Codd.

Remarkable Transatlantic Reception.

To the Editor of The Wireless World and Radio Review.

Sir,—An instance of unusual reception may be of interest to your readers.

Whilst in Lancashire, I decided to compare the results obtained in short wave reception as compared with reception at my station in London.

I was using a hurriedly arranged Reinartz type circuit with detector and one low frequency valve, and decided to try the effect as described in August *Q.S.T.*, of placing a short wave coil in parallel with the grid circuit in order to reduce the wavelength. On the waves around 50 to 70 metres, I received signals of colossal strength from various commercial stations testing with LPZ (Buenos Aires). Suddenly I tuned in a tremendous carrier wave with music and was astonished to find that this was KDKA! On changing over to a small loud speaker the transmission was audible out in the street, the announcer's voice fairly booming in the room. The reception strength was equal to **2 ZY**.

A noticeable feature was that for a considerable band on either side of KDKA's carrier, there was a very high-pitched heterodyne note—as in the Armstrong super. I have received many American broadcast programmes—always on detector and one L.F.—but never before of such tremendous strength!

Considering the short wavelength to which I was tuned, I can only put this reception down as a lower harmonic of KDKA—or a freak. The date was September 5th, 1924, at 03.00 B.S.T., and I should be pleased to know if any other of your readers recorded the same transmission. This reception was carried out at the station of Mr. Wilding (6 KB) in Wigan, Lancs., with a hurriedly thrown together "hay wire" tuner. The aerial is a 70 ft. single wire, 45 ft. high at the free end and 30 ft. at the lead in.

D. B. Knock (6 XG)

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Listeners in Northern France are complaining that the rapid development of German broadcasting between 400 and 450 metres is jamming the reception of British stations.

* * * *

The Merthyr Corporation has issued a regulation that council tenants having wireless installations must include lightning arresters in their aerials.

* * * *

Two Johannesburg amateurs report the reception of broadcasting from Pittsburg, U.S.A., using a five-valve set. The distance covered is approximately 7,200 miles.

* * * *

A Californian amateur, W. B. Maguer, is reported to have worked with F. Dillon Bell, of New Zealand, thus beating the record held by Carlos Braggio, the Argentine amateur.

* * * *

SHORT WAVE U.S. BROADCASTING.

News has been received that **KDKA**, the Pittsburg broadcasting station, is now operating on a wavelength of 68 metres. Transmissions are still continuing on 100 metres and the original wavelength of 326 metres.

WGY, the General Electric Company's station at Schenectady, now operates on a wavelength of 15 metres, simultaneously with their usual transmission. Great as are the difficulties in arranging a transmitter on this low wavelength, the task of reception is infinitely greater, and the experimenter who succeeds in this can be justifiably proud.

NEW SPANISH BROADCASTING STATION.

Trials are being carried out from the new Spanish broadcasting station in Barcelona, situated at the Hotel Colon.

For testing purposes a power of 100 watts is being used, but this will be increased to 1·5 kilowatts in a few months. The call sign of the station is **EAJ 1**, and the wavelength 325 metres.

We understand that transmissions are taking place between 6 and 7 p.m. and between 9 and 11 p.m. G.M.T. Arrangements have been made to broadcast opera from the Teatro Liceo, Barcelona.

VOCABULARY TROUBLE.

The desire in many quarters to repress American slang among British amateurs has a parallel in France, where English is being discouraged in the same fashion.

Lecturing at one of the final sessions of the Paris "Concours Lepine," Commandant Mesny asserted that such words as "fading," "loud speaker" and others of the same type, should have no place in the French amateur's vocabulary.

One argument challenges Commandant Mesny. The Frenchman who adopts English terms is in most cases speaking a legitimate tongue; the Englishman's adoption of American is rather different.

DX EXTRAORDINARY.

Difficulty in answering American calls because they were so numerous is reported by Mr. E. J. Simmonds (**2 OD**), of Gerrards Cross, Bucks.

In the early hours of Sunday, October 5th, Mr. Simmonds completed a new transmitting arrangement embodying a master oscillator. At 5 a.m. he called an American amateur, and was immediately greeted with answering calls from **1 BIP, 1 AUR, 2 BRC, 4 IO** and **4 OA** It is especially noteworthy that two of these came from the Fourth District (N. Carolina, etc.).

More remarkable still was **4 OA's** message, in which the operator stated that **2 OD's** signals were so strong that they were more comfortably read with the aerial disconnected.

On Monday, October 6th, Mr. Simmonds worked with **U1SF**, and on the following day with **U1MY.**

OFFICIAL OPENING OF ROME STATION.

The Marconi broadcasting station in Rome which has hitherto been engaged upon tests, began the regular transmission of programmes on October 6th. Concerts are given between 7.30 and 9.30 G.M.T.

The station operates on a wavelength of 422 metres and the apparatus consists of a Marconi 6 k.W. broadcasting transmitter of standard pattern such as is used in six of the British main stations and has been installed at Brussels, Cape Town, Durban, Lima and Rio de Janeiro.

TRANSMISSION UNDER DIFFICULTIES.

Owing to the stringent wireless regulations obtaining in Holland, amateur work has to be carried out somewhat stealthily. Some details of his experiments under restricted conditions, contributed by a Dutch amateur, may prove of interest.

The object of our correspondent, **OII**, was to discover what could be accomplished with simple apparatus, and without the aid of a special transmitting aerial or counterpoise.

Some promising results have already been obtained with a single wire aerial, 120 feet in length, slung between two houses, without masts, and insulated at each end by one small egg insulator,

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The counterpoise consists of two wires in the second storey of a building. The transmitter is of the loose-coupled reversed feed-back type, and employs a Telefunken detector valve. A plate supply of 800 volts unrectified A.C. is used, with a maximum aerial current of 0·2 amperes.

With this by no means promising combination, and operating on 80 to 100 metres, **OII** has worked with Italian, Swiss and French stations, including **1 FP, GAD, 8 LMT** and **8 UU**

On September 27th, at 11 p.m. (G.M.T.), two-way working was established with Swedish **SMZY**, a distance of 1,200 kilometres, using an aerial current of 0·18 amperes.

MYSTERIOUS BROADCAST PREACHER.

More than one report has reached us from listeners-in who have heard an unidentified station broadcasting religious addresses between 10.30 and 11 p.m. on Sundays.

Enquiry has shown that no B.B.C. station has been conducting such transmissions at this hour, and information as to the whereabouts of the transmitter would prove of interest.

According to one report the wavelength is in the neighbourhood of 420 metres.

GIANT U.S. BRAODCASTER ?

A broadcasting station with a power of 50 kilowatts, to be erected near New York, is the proposal of the Vice-President of the American Radio Corporation. The Company is ready to proceed with the work if no opposing regulations are introduced.

BROADCAST RECEPTION AT SEA.

Broadcast reception at sea usually provides valuable opportunities for signal comparison. Some notes on the reception of British and French stations have been forwarded to us by a correspondent sailing for New Zealand, who was able to make some interesting comparative tests.

A four-valve receiver was employed, as described in the *Wireless World and Radio Review* of July 9th and 16th, with the addition of grid cells in both L.F. stages.

When 375 miles out from Southampton, with an outside aerial, **2 LO** was at once picked up at excellent strength, and Paris was also tuned in with ease. Later in the evening **5 XX** was heard, and with careful tuning was separated from Radiola.

Good reception was also obtained at 700 miles out, but was marred by bad atmospherics. At 1,575 miles out faint orchestral music could be distinguished from Paris, but signals soon died away and our correspondent had to "pack up."

HAVE YOU HEARD CKAC ?

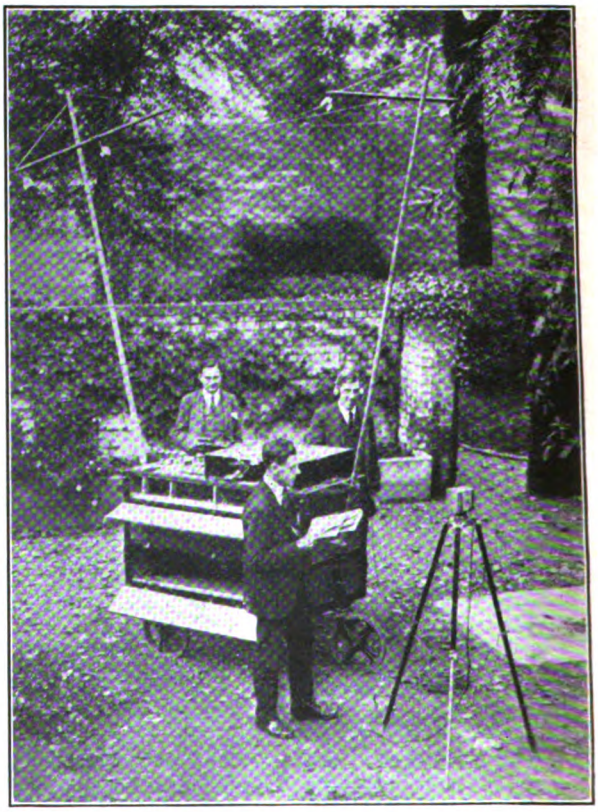
An important event in Canadian broadcasting occurred on October 4th, according to La Internacciona Ido-Radio-Klubo, when the Dominion's principal station, **CKAC**, increased its power to 28 kilowatts with new apparatus manufactured by the Canadian Marconi Company, of Montreal.

Owned and controlled by the great Canadian newspaper, *La Presse*, **CKAC** is the only French-English station in the world. It caters especially to some five millions of French scattered throughout the various provinces, several states of the Union, the island of St. Pierre Miquelon, and in the West Indies and Guianas. Three languages are employed in broadcasting, viz., French, English, and the international tongue, Ido.

The new apparatus employs fourteen valves of 2,000 watts each, one power amplifier, three oscillators, four modulators and six rectifiers. A feature of the set is that the energy, before going to the modulators, is treated to three-phase, double-wave rectification by means of the six valves mentioned. The ordinary commercial lighting energy being used to operate the transmitter, no motor generator is required, and rectification ensures absolute clarity and tone purity. The wavelength of **CKAC** is 425 metres.

FRENCH AMATEUR'S AMBITION.

Mr. L. J. Menars, the young French amateur, who claims the record for the reception of U.S. stations in France, and whose lists have appeared in the "Calls Heard" section of this Journal, is



The British Broadcasting Company's portable transmitter and microphone as used for broadcasting from the Zoo. Captain West, Chief of the Company's Development Staff, is seen in the background.

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about to commence transmission work, with the call sign 8 EJ. He intends to confine his operations to the 40-100 metre band.

Using an input of 500 watts and an 80 ft. cage aerial, Mr. Menars hopes to work with America without difficulty, after which he will then turn his attention to the Argentine. If he is again successful, he will attempt to reach New Zealand!

THE JUNIOR INSTITUTION OF ENGINEERS.

A full programme of papers and lecturettes has been prepared for the coming session of the Junior Institution of Engineers, covering a variety of subjects of present-day interest. On October 17th, at a special meeting, a lecture on "High Voltage Electric Oscillations" will be delivered by R. P. Howgrave-Graham, M.I.E.E. A Lecturette on "Audio-frequency Transformers," will be given by H. J. N. Riddle (Assoc. Member), on Friday, October 31st.

Further particulars of these meetings and tickets of admission may be obtained from the Secretary at 39 Victoria Street, S.W.1.

A USEFUL BROADCAST TIME TABLE.

An excellent time table of Continental Broadcasting has been produced by Messrs. E. T. W. Dennis & Sons, Ltd., of Melrose Street, Scarborough. Transmissions are arranged in order of time, with the object of facilitating identification of unknown stations at any time of the day or night. Our only criticism is that the times should have been given as G.M.T., not B.S.T., as the book will be used principally during the coming winter. The price of the time-table is 4d.

WIRELESS AND CHANNEL FOGS.

With the approaching season of fogs, the Board of Trade and the Post Office authorities have taken a timely step in deciding to erect a wireless directional station at Niton, Isle of Wight.

The alleged inadequacy of present provision for fog on the British coasts has been the subject of some criticism and it is suggested that the Lizard station should also be improved to meet the need. This, however, is a matter for the Admiralty, which is the controlling authority.

CANADIAN WIRELESS REGULATIONS.

It is announced by the Canadian Marine Department, as a result of negotiations with the British Shipping authorities, that a wireless wavelength of 450 metres must no longer be used within 250 miles of the coasts of Canada or of Newfoundland, says a Reuter message from Ottawa. Canadian ships must refrain from using the same wavelength at the same distance from the coast of the British Isles. Great Britain, the announcement adds, undertakes to persuade Continental countries to take similar action.

INTERFERENCE PREVENTION.

Some instances of interference were discussed by Mr. Maurice Child, speaking recently from 2 LO on behalf of the Radio Society of Great Britain.

Mr. Child referred to an extract from the American Radio Service Bulletin, in which two sources of radio interference and the manner in which they were effectively overcome are reported.

"The first trouble," said Mr. Child, "was produced over a large area by the operation of a precipitator. For the benefit of those who may not be acquainted with the function of this device I would mention that it is for precipitating particles of coal or other matter which have not been consumed in the furnaces, thereby preventing a considerable pollution of the surrounding atmosphere. The precipitation is accomplished by maintaining a series of conductors inserted in the chimney stack or up-take, at a very high difference of continuous electrical pressure—something to the order of 60,000 volts.

"The apparatus which produced this electrical energy incidentally also functioned as a free emitter—although quite unintentionally, but was subsequently prevented from so doing by the insertion of suitable resistances in the high voltage wires, and shunting a closed oscillatory circuit across a spark gap which formed part of the plant.

"The other cause of interference was due to a defective overhead power line working at a pressure of 13,000 volts situated in the town of Augusta, U.S.A., and supplying nine arc lighting circuits, although actually tungsten lamps were in use in place of the original arcs. It was found that one of these circuits was exceptionally bad, and the maximum disturbance was traced with a three-valve receiver connected to a frame aerial, to a certain street standard supporting one of the lamps. The lamp was dead short-circuited without effect, but careful investigation involving considerable patience and time eventually led to the discovery that one of the standard guy wires was periodically lying across a 2,300 volt circuit, and all the trouble ceased on the defect being rectified.

"About a year ago the Radio Society of Great Britain invited an inspection by the Southern Railway Company of their overhead lines for the electrified system between Victoria and the Crystal Palace, with excellent results to the listening public in the neighbourhood of Balham."

Mr. Child stated that his object in mentioning these instances was to indicate that it is possible to trace and cure various troublesome kinds of interferences. He invited members to assist in locating them, for by so doing they would not only learn interesting facts themselves, but might obtain some measure of gratitude from the non-technical public.

AN ERROR.

We regret that by an unfortunate error, a photograph appeared in the left-hand column on page 25 of our issue of October 1st, purporting to depict a cabinet receiver of Messrs. Edison-Swan Electric Co. The receiver illustrated is actually the Marconiphone V.1.

CHANGE OF ADDRESS.

Owing to the growth of their business, Messrs. G. W. I., Ltd., component distributors and valve repairers, have removed their offices to Imperial House, 43 Grafton Street, Tottenham Court Road, London, W.1.

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Calls Heard

Hammersmith, London, W.6.
American and Canadian: 1 AQ, 1 AR, 1 AJA, 1 ALJ, 1 ARR, 1 ASU, 1 BDI, 1 CK, 1 CMP, 1 CRU, 1 DD, 1 MO, 1 IV, 1 WRT, 1 XA, 1 XW, 1 XAK, 1 XAR, 2 AGB, 2 AWY, 2 BG, 2 BY, 2 CY, 2 LZ, 2 WR, 2 XAA, 3 BP, 3 BG, 3 IL, 3 IM, 3 OE, 3 OT, 3 TE, 3 TK, 3 VW, 4 AA, 4 BZ, 4 LV, 4 TN, 5 EV, 5 XA, 6 BCL, 6 BY, 7 DF, 8 ABM, 8 FM, 9 EFH, 9 XG. Dutch: 0 AA, 0 AG, 0 BA, 0 BQ, 0 FN, 0 KF, 0 KX, 0 KZ, 0 MR, 0 MS, 0 NN, 0 PB, 0 PC, 0 PZ, 0 RV, 0 SA, 0 XW, 0 YS, 0 ZB, PA 5, PA 9, PCII, PCGG, PCTT. Danish, Belgian, Italian: 7 EC, 7 QF, 7 QG, P 2, P 5, W 2, 4 C 2, 1 CF, 1 ST, ACD, MU. French: 8 AA, 8 AB, 8 AE, 8 AE 2, 8 AE 3, 8 AE 4, 8 AG, 8 AL, 8 AZ, 8 BF, 8 BM, 8 BT, 8 CC, 8 CG, 8 CH, 8 CM, 8 CS, 8 CT, 8 CZ, 8 DO, 8 DU, 8 EI, 8 EN, 8 EO, 8 JC, 8 JL, 8 OH, 8 OL, 8 QA, 8 RL, 8 ZM. (o—v—2.) (S. Riesen).

Hove, Sussex (August 22nd-September 12th).
Below 100 metres:—British: 2 GW, 2 KF, 2 KZ, 2 LS, 2 NM, 2 VW, 2 XY, 2 YT, 5 DH, 5 LF, 5 LS. French: 6 EX, 6 TD, 6 TM, 6 XX, 6 QB, 8 AQ, 8 BN, 8 BV, 8 CO, 8 DA, 8 DD, 8 DI, 8 DO, 8 DV, 8 DX, 8 FK, 8 FL, 8 FQ, 8 FSF, 8 SHL, 8 ML, 7 MN, 8 OK, 8 QI, 8 SR, 8 VU, 8 VG, 8 VR, 8 WS, 8 XR. Belgian: 4 AA, 4 AD, 4 RS, 4 WR, W 2, P 2. Dutch: 0 BA, 0 MS. Danish: 7 VG. Swedish: SMZS. Unknown: 9 AD, 3 AD, 3 CA. Amateurs on 200 metres:—British: 2 KA, 2 OM, 5 MS, 5 VN, 5 TZ, 6 QB. (o—v—1.) (C. L. Fry).

Islington, London, N. (September 1st-11th).
1 AR, 2 AJR, 2 CC, 2 FV, 2 IH, 2 NM, 2 VW, 5 MA, 5 NW, 5 OC, 5 OT, 5 SI, 5 SZ, 5 TJ, 6 AL, 6 BY, 6 FV, 6 MP, 6 US, 7 AB, 8 FK, 8 SM, 8 WJ, 8 ZZ, 0 BA, 0 GC, 0 HD, 0 QW. (o—v—1.) (J. G. Sandford).

Wembley (July 13th-September 7th).
2 FA, 2 FN, 2 FP, 2 FV, 2 JA, 2 JB, 2 JP, 2 OA, 2 TA, 2 WY, 2 YO, 2 ZA, 2 AJA, 2 AQV, 2 ATI, 2 AUJ, 2 CAA, 5 AR, 5 BH, 5 CQ, 5 GA, 5 KM, 5 OC, 5 RB, 5 SU, 5 SZ, 5 VN, 6 EY, 6 GH, 6 KG, 6 QA, 6 TA, 6 UD, 6 VP. French: 8 AE 4, 8 AP, 8 BA, 8 BN, 8 BS, 8 BU, 8 BV, 8 CZ, 8 DI, 8 DU, 8 EE, 8 EX, 8 FL, 8 FNM, 8 FQ, 8 FSF, 8 G 4, 8 JBV, 8 JHL, 8 ML, 8 NS, 8 PA, 8 RX, 8 SR, 8 UU, 8 VG, 8 WZ. Dutch: 0 BQ, 0 HD, 0 MS. Luxembourg: 0 AA. Belgian: 4 MG, 4 RS, 4 WR, 4 YZ. Italian: 1 FP, 1 MT. Swedish: SMZS, SMZV. American: 1 AHM, 1 CCG, 2 CK, 2 CRP, 2 OVJ, 2 WZ, 3 LR, 4 SA, 8 ADG. Canadian: 1 BQ, 1 MF. Unknown: 3 AD, 9 AD, CP, 3 XO, YA 13. (o—v—o.) (A. L. Carrad).

Holyhead (Saturday, September 6th, 1924, 12.0 midnight to 3.30 a.m., B.S.T.).
American: 1 BLX, 1 XAK, 1 XDB, 1 AMW, 1 AAL, 1 MY, SF, 1 FD, 1 ALI, 1 BTA, 2 BRB, 2 GK, 2 CU, 3 MB, 4 FS, 5 LI, 6 CRW, 8 ADD, 8 ZG, 9 DPX, 9 ZB, 9 ZC, 9 ARF, 9 AYX. Argentine: OE 8(?). (R. E. Williams).

CLUB ACTIVITIES.

Correspondence for Secretaries of Societies will be forwarded if addressed to the office of this Journal, c/o the Editor.

Mr. L. F. Fogarty, A.M.I.E.E., provided an interesting lecture on "Inductance and Capacity" at the last meeting of the Croydon Wireless and Physical Society. By means of mechanical analogies and blackboard illustrations Mr. Fogarty rendered his remarks sufficiently clear to be understood by the beginner.

* * * *

"Measuring Instruments used in Amateur Radio" were dealt with by Mr. G. A. V. Sowter, B.Sc., lecturing before the Walthamstow Amateur Radio Society on October 2nd. The lucid manner in which he demonstrated by means of a compass, accumulator, some iron core and a few yards of wire, added considerably to the value of the lecture.

* * * *

"Wireless: Past, Present and Future," formed the title of an instructive and entertaining lecture delivered by Mr. H. R. Rivers-Moore, B.Sc., at the opening meeting of the South Croydon and District Radio Society. From 10 till 12 o'clock, an enjoyable dance was held to the strains of the Savoy bands on the loudspeaker.

* * * *

Permission to attend a series of wireless lectures to be given by Professor W. A. Andrews, B.Sc., at the Merchant Venturers' Technical College, has been obtained for members of the Bristol and District Radio Society. These lectures are educational and are divided into two courses, elementary and advanced. The last two or three lectures in the latter course will be on the subject of transmission.

* * * *

At a time when there is much dissatisfaction being expressed as to the behaviour of the Post Office in the issue of transmitting permits, the Hampstead and St. Pancras Radio Society ask us to state that they made application for a licence on September 16th last and received a reply on October 9th awarding them most liberal transmitting facilities.

The Society makes the suggestion that the Post Office will act in a perfectly sane manner if approached with reasonable courtesy, and if no technical details are withheld such as would assist in deciding to grant the privilege of conducting experiments with transmitting apparatus. After all, the Post Office must have something to go upon.

* * * *

The Bognor and District Wireless Society opens its session on Monday, October 20th, with a meeting at 8 p.m. at the *Observer* offices, Lennox Street. All enthusiasts are invited to attend.

* * * *

Regular Morse practice at each meeting features on the programme of the Middlesex Wireless Club.

On October 1st Mr. Gartland lectured on "H.F. Amplification for Reflex Circuits," giving many useful hints, and describing common pitfalls.

FORTHCOMING EVENTS.

WEDNESDAY, OCTOBER 15th.

North Middlesex Wireless Club. Half-yearly Sale of Instruments.

Radio Research Society, Peckham. At 44 Talfourd Road. Discussions: "Sources of Electric Current," "Some Experiments with Room Aerials."

Bristol and District Radio Society. Demonstration by Messrs. Siemens and English Electric Lamp Co.

Clapham Wireless and Scientific Society. At 7.45 p.m. At 67 Balham High Road. Annual General Meeting.

THURSDAY, OCTOBER 16th.

Bournemouth and District Radio and Experimental Society. At 7 p.m. At Canford Hall, St. Peter's Road. Short Talks, Evening Lecture: "Standard Circuits and their Characteristics." By Mr. W. H. Peters, B.Sc.

Derby Wireless Club. Lecture by Mr. E. F. Clark, B.A., B.Sc.

Walthamstow Amateur Radio Society. Lecture: "An International Language for Radio." By Mr. Montague C. Butler, L.R.A.M.

FRIDAY, OCTOBER 17th.

Bristol and District Radio Society. Demonstration by General Electric Company. "Manufacture of Wireless Valves."

MONDAY, OCTOBER 20th.

Hackney and District Radio Society. At 8 p.m. At King's Hall, Lower Clapton Road, E.8. Query Night.

WEDNESDAY, OCTOBER 22nd.

Radio Society of Great Britain. Ordinary Meeting. At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Unsolved Problems of Wireless." By Mr. R. H. Barfield, M.Sc.

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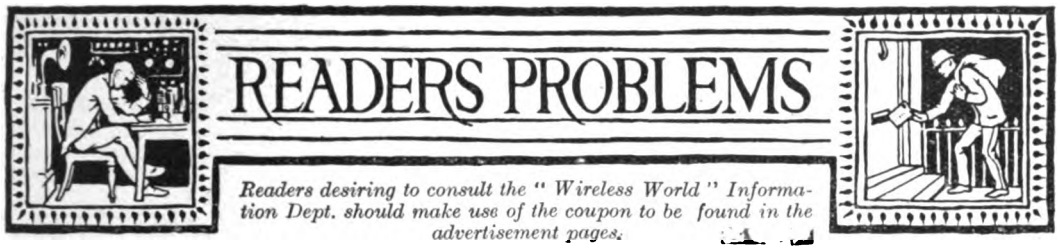
READERS PROBLEMS
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

PLOTTING CRYSTAL CHARACTERISTICS.

FROM the static or D.C. characteristics of a crystal detector it is possible to predict with a reasonable degree of accuracy whether the crystal will be suitable for use in a wireless circuit, and also to determine the conditions under which it will give best results.

The apparatus necessary to obtain the curve is very simple, and consists of a sensitive high resistance galvanometer, a potentiometer wire such as a metre bridge, a 2-volt accumulator, and, as a refinement, a reversing switch for the battery.

The method of connecting up the apparatus is illustrated in Fig. 1 (*a*). If the metre bridge wire is of uniform cross section and conductivity, there will be a uniform fall of voltage along the whole length of the wire, so that a series of known voltages may be applied to the crystal detector by varying the position of the tapping point on the wire. The current flowing through the crystal contact for each value of the applied voltage will be indicated by the galvanometer G, which should be of the suspended moving coil type, used in conjunction with a lamp and scale. Having obtained a series of galvanometer deflections for various positions of the potentiometer slider, the battery should be reversed, and a further series taken, with the E.M.F. applied in the opposite direction. Before plotting the curve it will be necessary to reduce the galvanometer and potentiometer scale readings to absolute values of current and E.M.F respectively. Where great accuracy is not required, the E.M.F. may be obtained by measuring the voltage of the accumulator with a voltmeter, and assuming that this is the potential difference between the ends of the meter bridge wire. A more accurate method of calibration is indicated in Fig. 1 (*b*). A standard cell, S, of the Weston or Clark type, is connected in series with the galvanometer, care being taken that the polarity of the cell is arranged to oppose the E.M.F. due to the accumulator cell. The slider contact is then adjusted until no current flows through the galvanometer. The length of bridge wire XY will then be equivalent to the E.M.F. of the standard cell. A key is placed in the galvanometer circuit, so that this circuit may be broken instantly if the galvanometer indicates that an excessive current is flowing through the standard cell. The current delivered from a standard cell should never be allowed to exceed 1 microampere, and a current of this value should not be allowed to flow for more than a few seconds. The galvanometer scale readings may be reduced to microamperes by connecting the standard cell in series with the galvanometer, and a standard resistance, R, of 1 megohm.

The circuit for the calibration of the current is given in Fig. 1 (*c*).

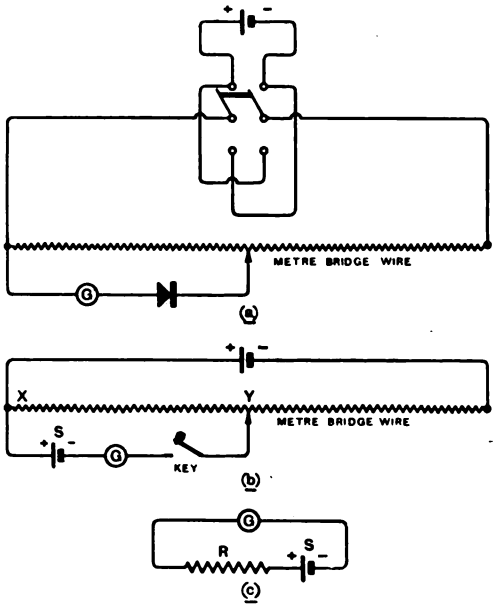

Fig. 1. *Circuits for plotting crystal characteristics.*

CALCULATION OF ANODE RESISTANCES.

THE external resistance connected in the anode circuit of a valve for H.F. or L.F. amplification should have a value several times as great as the anode-filament resistance of the valve. The higher the ratio of the external resistance to the resistance of the valve, the higher will be the amplification obtainable from each stage. The upper limit to this ratio is determined in practice by the size of the H.T. battery which can be used. As the value of the anode resistance is increased, the H.T. voltage must be increased also to compensate for the fall of voltage through the resistance and to ensure that the potential difference between the anode and filament of the valve is sufficiently high. The total H.T. voltage will be divided in the ratio of the external and internal resistances.

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The *internal resistance* of the valve for a given H.T. voltage and filament current is dependent on the grid voltage and may therefore have a value different from the *impedance* of the valve which is calculated from the valve characteristics.

In calculating the value of an anode resistance it is usual to start by fixing the value of the H.T. battery. To take a concrete example, let us assume that 200 volts is the maximum H.T. voltage that it is practicable to employ. If the valve takes a steady anode current of 1·5 milliamperes at 80 volts when a suitable negative grid bias is applied it is a simple matter to calculate the value of the anode resistance from Ohm's law, for this resistance must dispose of the remaining 120 volts when a current of 1·5 milliamperes is passing. The resistance required is therefore 120 divided by 0·0015, or 80,000 ohms.

Starting with a fixed value for the anode resistance, and knowing the conditions under which the valve is to be operated, the H.T. voltage required can be calculated by a similar process.

A Four-Valve and Crystal Receiver for Broadcast Reception.

THE diagram given below shows the method of connecting a useful four-valve and crystal circuit, with two stages of H.F. amplification, crystal rectification, and two stages of transformer-coupled L.F. amplification.

Tuned anode coupling is employed for the H.F. stages, and a potentiometer is included to control the grid potential in the case of these valves. Separate H.T. tappings are provided for the H.F. and L.F. valves, and a switch is included to cut out the last note magnifier when sufficient signal strength is obtained with three valves.

The use of two stages of H.F. amplification enables the range of the receiver to be increased without the use of reaction, which is a frequent cause of distortion. The set should therefore be capable of giving a high quality of reproduction if the transformers and valves in the two L.F. stages are chosen with care.

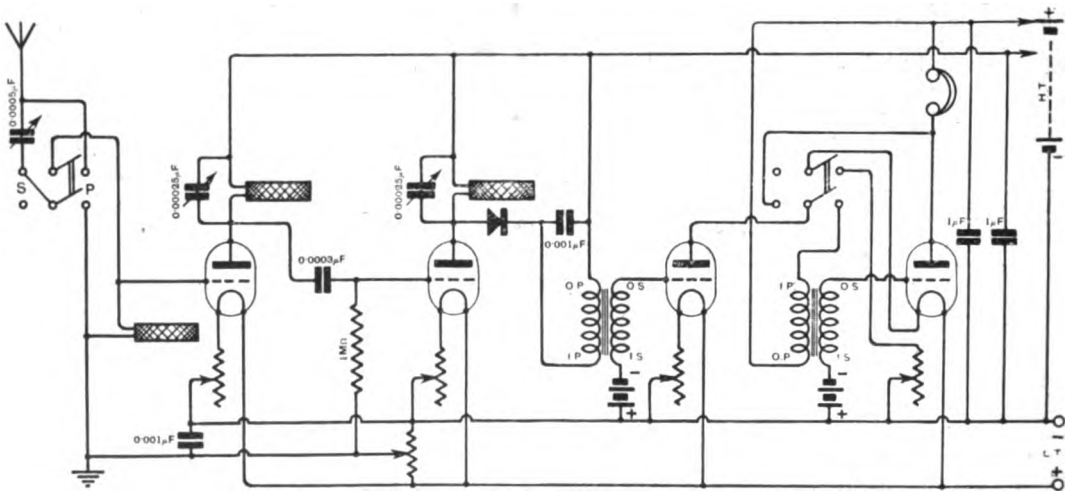

Fig. 2. A four-valve and crystal receiver for broadcast reception.

Couplings Between H.F. Valves.

A READER asks if a H.F. coupling consisting of two plug-in coils coupled together to form a transformer would give better results than the tuned anode method of coupling.

The results obtained with a coupling of this kind would not be very much better than those obtained with tuned anode coupling, as far as signal strength is concerned, but if both coils are tuned and a variable coupling is provided, it would be possible to obtain a much higher degree of selectivity than is possible in the case of tuned anode coupling. The method can therefore be regarded as superior to tuned anode coupling.

H.T. Supply from D.C. Mains.

REFERRING to the diagram on page 725 of the issue of September 17th, 1924, a reader asks if it would be possible to obtain more than one positive tapping from the H.T. supply.

This could be done quite easily by arranging three instead of two lamps in series. The two H.T tappings would be taken from either side of the centre lamp, and an additional smoothing choke would have to be connected in the new H.T. lead. Condensers should then be connected between each side of the choke to the negative lead in the usual way. One condenser is connected on the side of the chokes nearest the lamps, and the other across the H.T. output terminals.

Under certain circumstances the choke in the negative lead may be omitted without affecting the results. If it is found in actual practice that this can be done, the choke might be used for the new positive tapping.

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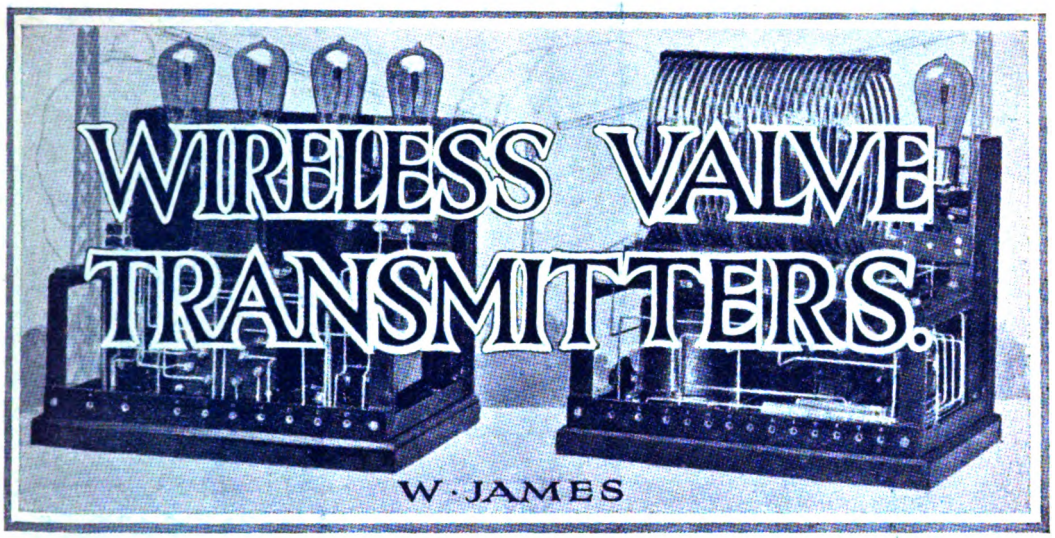

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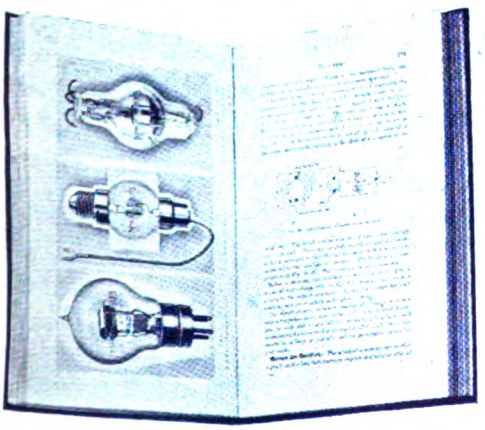

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

THE POSTMASTER-GENERAL'S STATEMENT.

IN view of the dissatisfaction which exists at present, and has been voiced by the Radio Society of Great Britain, on account of certain Post Office restrictions to free experiment, we feel that special attention should be drawn to the recent statement made by the Postmaster-General.

A question was put by Mr. T. Thomson (Member for Middlesbrough West) asking if the Postmaster-General was aware of the dissatisfaction existing amongst wireless amateurs at the present restrictions which prohibited messages being transmitted abroad; and whether he would revise the existing rules with a view to removing all restrictions which are an obstruction to free experiment and research. In reply the Postmaster-General made the following statement:—

"It is the present practice to grant permission for *bona fide* experiments with places abroad when special application is made. Many such permits have already been issued, and arrangements are being made with the Radio Societies for the grant of increased facilities for experiments, which will be carried out by their members in co-operation with amateurs in the United States and many other countries. The general conditions governing the grant of licences for wireless transmission were adopted after consultation with the other interests concerned, including the radio societies. Some restrictions are necessary in order to prevent interference with other services, but I am at all times prepared to consider any definite suggestions which the radio societies may put forward for altering the rules."

Such a statement coming from the Postmaster-General at the present juncture constitutes, in our opinion, an invitation to the amateur which should under no circumstances be ignored. If the attitude of the Post Office is that they are prepared to reconsider the whole question of the regulations governing amateur use of wireless, then it is up to the amateur, as represented by the societies, to assist in every possible way in the framing of such regulations as will give him all reasonable freedom, whilst at the same time reserving to the Post Office sufficient control to prevent the abuse of privileges granted, and to ensure that interference with Government and commercial traffic shall not occur.

We believe that the right course to adopt at the present time is to accept this invitation in the friendliest spirit, and to put in the background all thought of antagonistic action until every channel for harmonious agreement on both sides has been fully explored.

THE TRANSOCEAN AMATEUR TESTS.

AT the time of writing, the Transatlantic (or rather this year we should say the Transocean) Amateur Tests have started, and it is to be expected that far-reaching achievements will result. At the moment of writing news comes to hand that New Zealand **4 AG** has actually been heard in this country by Mr. E. J. Simmonds, **2 OD.** Provided that this remarkable feat is confirmed, relay working with Australia and New Zealand becomes almost a certainty before the conclusion of the winter season, unless the summer weather now starting in the Antipodes presents an insuperable obstacle.

We reproduce here in miniature, a map which is of special interest in connection with the Transocean Tests. It has been drawn on a special projection so as to show correct

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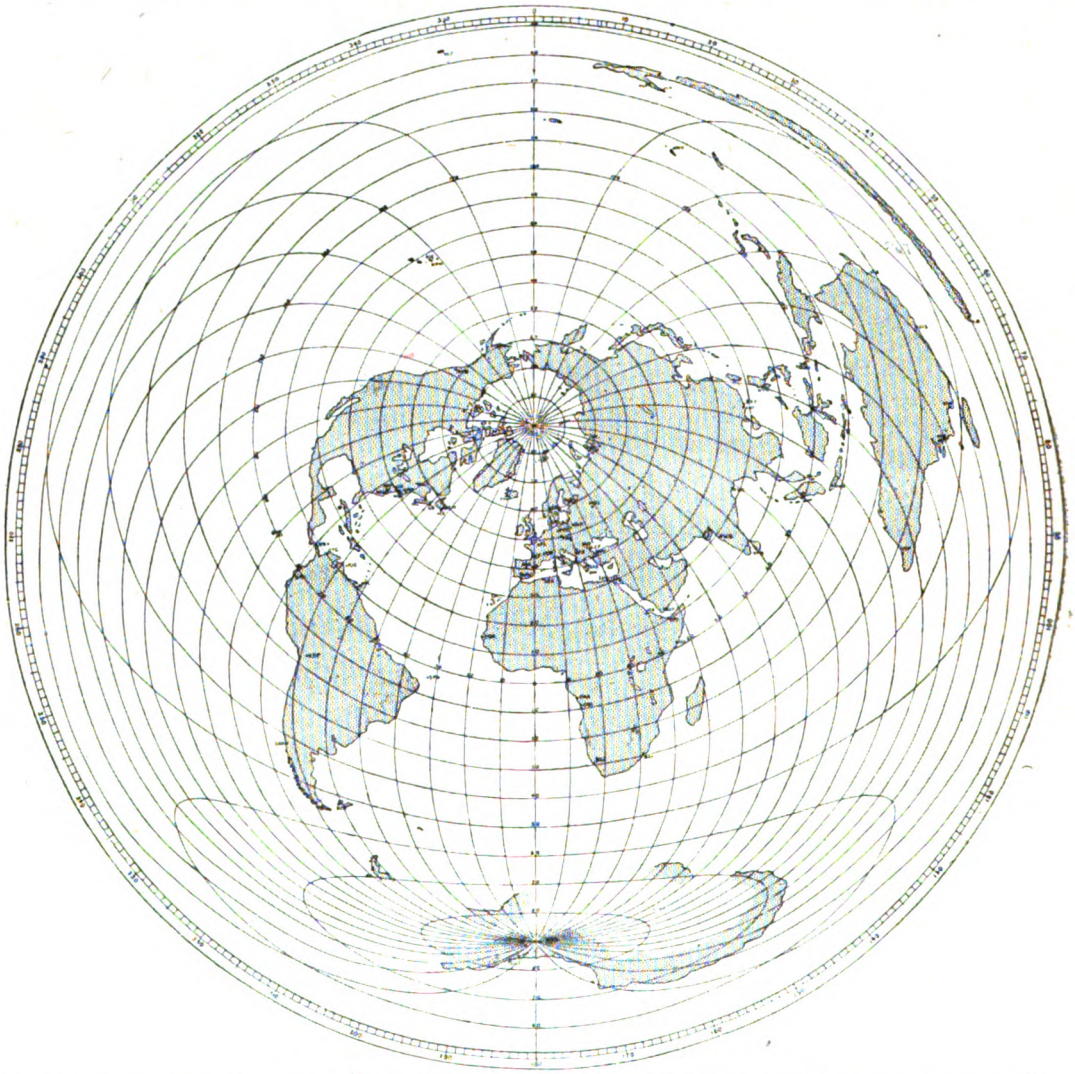
distance and directions of any place from England, London being taken as a centre.

The map was compiled specially for The Wireless Press, Ltd., by the late Mr. J. St. Vincent Pletts, and although it has already been found extremely useful in connection with long distance transmission records during previous tests, its value is greatly enhanced this year, when the transmissions are no longer confined between this country and the United States of America, but are extended in addition to more distant parts of the globe.

The great feature of the tests to be conducted this year is relay work from point to point which has not been attempted during previous tests. It will be remembered that in the communications with the United States, prior to the success of last year, the main object was to get across, but now that inter-communication has been so firmly established and maintained by quite a large number of amateurs, it is possible to extend the activities and introduce these schemes for relaying.

THE EDITOR.



This chart, which has been considerably reduced from the original, gives the direction and distance from London to all parts of the globe, and is invaluable in amateur intercontinental work. The scale of the original is 1 in. to 1,000 miles, or 1·5 cm. to 1,000 kilometres and the scale of the above is approximately 1 in. to 4,370 miles.

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OSCILLATING CRYSTALS.

The author of this article, Mr. O. Lossev of Russia, has in a comparatively short space of time achieved world-wide fame in connection with his discoveries of the oscillating properties of certain crystals. At our request Mr. Lossev has contributed for publication in *The Wireless World and Radio Review* this important article dealing with observations on the behaviour of crystals whilst in an oscillating condition. Of special interest are the illustrations in Figs. 3, 4 and 5, showing actual photographs taken of the point of contact of the crystal in operation. The author questions whether this luminosity is due to actual arcing at the point of contact or to electronic bombardment. Fig. 6 illustrates the first oscillograph records ever obtained of the wave form of oscillations produced by crystals.

By O. LOSSEV.

SINCE the attention which has been drawn to the use of crystals as oscillators and amplifiers, I have been carrying out further research work, devoted essentially to an investigation of the process by which oscillation is set up.

It has probably been apparent from articles already published that I hold the idea that generation is caused by a microscopical arc which occurs at the point marked i_0 in the graph shown in Fig. 1. However, the electrodes of this arc are not incandescent, and the temperature rise at the point of contact does not exceed 100° C. Referring again to the upper curve in Fig. 1, only small discharges take place across the gap around the contacts, which has the effect of deflecting the initial part of the characteristic curve from a straight line.

With a view to gaining a better understanding of the operation of contact detectors I will deal with the problem under the following headings :—

1. The influence of temperature on the generating contact.
2. The effect of the temperature gradient produced by external heating.
3. The coefficients of crystal resistance change depending upon the temperature.
4. The luminescence produced at the contacts of the carborundum detector.
5. The luminescence of the contact of the generating zincite detector.
6. The wave form of the generated oscillations.
7. The generating characteristic of tinstone.

(1) *The Influence of Temperature on the Generating Contact.*

A series of characteristic curves have been plotted with the generating point at various temperatures, heat being applied externally, which indicated that the contacts of a generating detector, when working, are, in fact, very feebly heated. It was apparent from these curves that the generating properties of the contact changed considerably as the temperature rose to 60° C., and it was also observed that the negative resistance diminished. Another property which was noticed was that different results were obtained while the crystal was in the process of cooling.

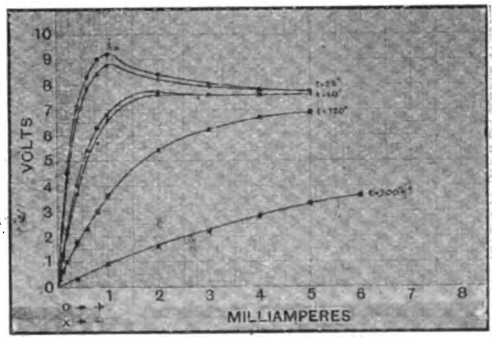

Fig. 1. Curves showing the conductivity of a zincite-steel wire detector with various applied potentials and under varying conditions of temperature. The curve at the top and that third from top are plotted with the positive of the applied current to the steel wire, while the second and fourth were given with the positive to the zincite. The fifth and sixth curves indicate no change in conductivity with current reversal.

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The series of curves given in Fig. 1 were obtained with crystal contacts operating at various temperatures. The crystal used for plotting these curves consisted of a contact between a steel wire and a specimen of zincite and the direction of the applied current across the contact was reversed. This is indicated in the curves by marking the plotting points, either by O or X.

(2) *The effect of the temperature gradient produced by external heating.*

The curves showing the effect of the temperature gradient when heat is produced by external means are shown in Fig. 2. In this instance the heater was placed at

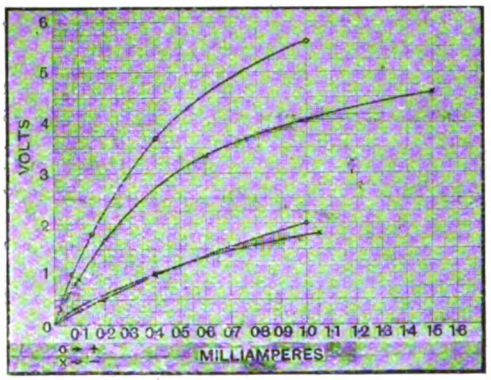

Fig. 2. The effect of applying heat by conduction from the steel wire is shown in the lower two curves. The curves with plotting points marked O were given with the applied positive potential to the steel wire, and the points marked X with current in the reverse direction. The scale of plotting is enlarged as compared with Fig. 1 and the curves are only taken to a point equivalent to i_o (Fig. 1).

some distance from the zincite crystal, the heat being conducted to the contact points through the steel spring, which also served as a contact. As the heat in this case is reaching the contacts mainly through conduction by the steel wire, a temperature gradient is produced from the wire to the crystal. The characteristic working under normal conditions, is given by the upper two curves and the lower curves show the results obtained with external heat applied, and conducted to the contact by the steel wire.

The portions of the characteristics to the point i_o only are shown, as this simplifies the graphs and enables a clearer conception to be gained of the asymmetry. This asymmetry of the positive curve, in comparison with the negative one, changes in the opposite direction if a temperature gradient is externally produced. If the contact is uniformly heated this asymmetry change does not take place. The asymmetry may also be explained as follows. If the point of the metal contact wire is not heated from outside it attains a rise of temperature due to the Joule effect, during the operation of the detector. Therefore the thermionic emission from this point when serving as a cathode is not so great as that of a crystal serving as a cathode and becoming heated to a greater extent owing to the poor heat conducting properties of the crystal.

If we now produce, by means of external heating, a temperature gradient across the detector from the contact point to the crystal, it will be evident that the characteristic must change in the opposite direction, for the point being heated to a greater extent its themionic emission will be greater than when it is operating as a cathode. With stronger currents (on Fig. 2 more than 0·4 milliampere) the character of asymmetry does not change, as the Joule effect is already so great that the effect it produces prevails.

The necessity for making the wire point the cathode is due to a greater negative resistance being obtained. This is explained by the different heating properties of the point and the crystal, which produce a smaller thermionic emission.

The ordinary detection effect may also be partly explained by the different cathode and anode heating of the contact detector.

(3) *Co-efficients of crystal resistance change depending upon the temperature.*

Calculations made by Mr. G. Ostroumoff prove that the coefficient for magnetite is 1, for carborundum 2, and 3 for the best zincite. These are negative, and correspond to (1) 0·0065, (2) 0·0027 and (3) 0·007.

(4) *Carborundum Contact Luminescence.*

Many attempts have been made to discover the hypothetic voltaic arc at the detector contacts with the aid of a microscope. Two years ago a rather strong luminescence was observed with the naked eye at the contact of a carborundum (—) and a steel wire detector, with a direct current flowing

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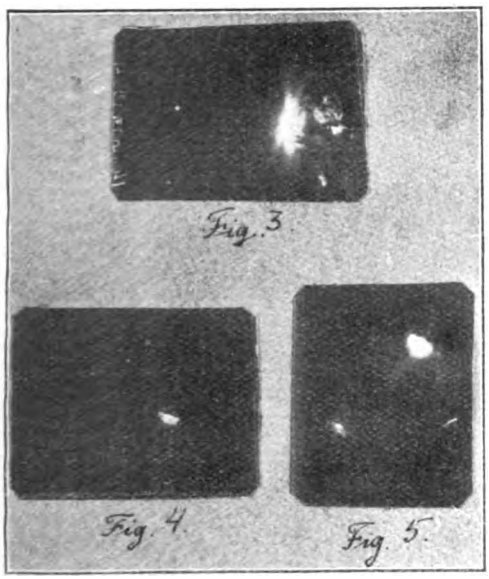
through it from the crystal to the wire. After a detailed investigation under the microscope it was found that the luminescence disappeared if the pole signs were changed, although this makes the direct current value greater. Ordinary detection depends upon this luminescence, and it may be observed beginning from currents of a value higher than 0·1 milliampere.

Microscopic photographs, magnified 120 times, are shown in Figs. 3, 4 and 5. They appear to show a microscopic electron discharge which it would seem emanates from the crystal, due to the bombardment of the electrons, in a similar manner to the luminescence of different minerals in the Crooke's tube. It has already been mentioned that the luminescence takes place only when the cathode is a metallic electrode.



Figs. 3, 4 and 5. Some interesting microphotographs of the luminescence occurring at the contacts of a detector. Magnified 120 times.

Taken with a very short exposure, Fig. 4 shows the stratification of light near the contact electrodes, whilst Fig. 5, on which the same point of the crystal was taken with a longer exposure, shows the whole spot of light. From Fig. 4 it is a simple matter to calculate the cross area of luminescence, which is 700 microns wide. Investigations will also be made regarding the spectrum of the carborundum luminescence.

(5) *Generating Zincite Contact Luminescence.*

It has been found that the carborundum contact rarely generates, in spite of the

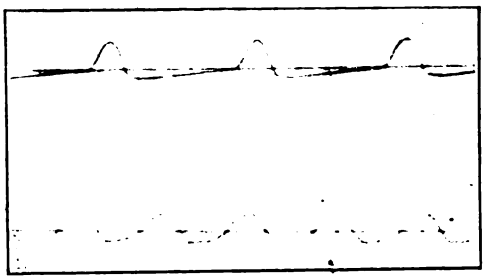


Fig. 6. Oscillograph records showing the waveform of the oscillations set up by a zincite detector.

profuse electronic discharge. This can be explained by the low conductivity of the crystal in comparison with zincite, and also by the nature of the crystal surface and its heating, which gives no negative resistance effect. Attempts have been made to observe a similar luminescence with a zincite contact during generation, but as in this case the crystal is opaque the surface roughness prevents the possibility of observing any possible luminescence.

When currents of more than 5 milliamperes are flowing through the detector, however, the luminescence can be clearly seen, but oscillations are generated only at its commencement. With small currents of the order of 0·3 to 0·5 milliampere, even if the contact does generate, luminescence can rarely be observed.

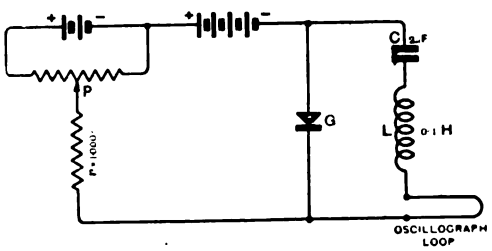


Fig. 7. The oscillating crystal circuit used for taking oscillograph records.

(6) *The Wave-form of the Generated Oscillations.*

Oscillographs of the generated oscillations taken by Mr. A. M. Coogusheff, are shown in Fig. 6, (*a*) with a comparatively large

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negative detector resistance, and (*b*) with a smaller resistance. In these experiments the oscillograph loop was directly connected to the oscillating detector circuit, as is shown by Fig. 7.

(7) *The generating characteristic of tinstone.*

During the period of these experiments more than fifty different natural minerals have been investigated with regard to the generation of oscillations, and it has been found that, next to zincite, tinstone generates rather well. Although pyrrotite, bornite, magnetite, carborundum and corellite were fairly satisfactory, their generating properties did not equal zincite or tinstone.

With tinstone, as can be seen from its characteristic curves (Fig. 8), oscillations commence at 3 to 8 milliamperes and 2·5 to 3 volts.

Referring to Mr. Leslie Miller's letter in *The Wireless World and Radio Review* of June 25th, 1924, it may be stated that the practical use of generating detectors wholly depends upon the quality of the crystal. In my laboratory good zincite crystals producing stable and regular oscillations were obtained by fusing zincite in an arc. These oscillations were maintained with the same frequency and amplitude for more than three days, despite the mechanical shaking to which the detector was submitted.

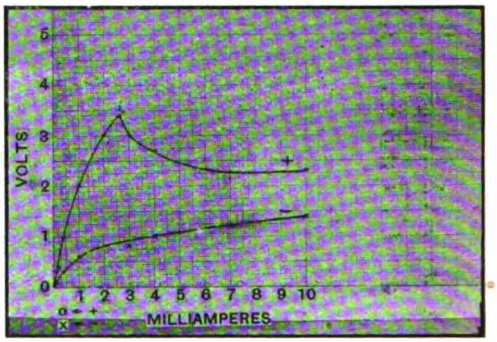
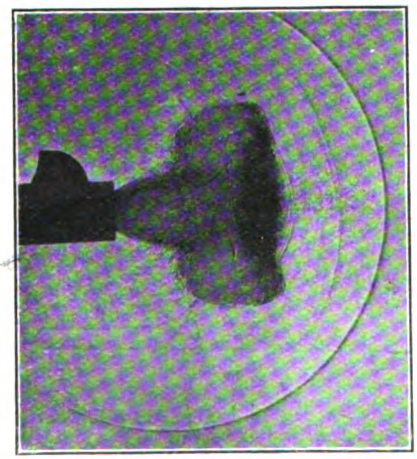
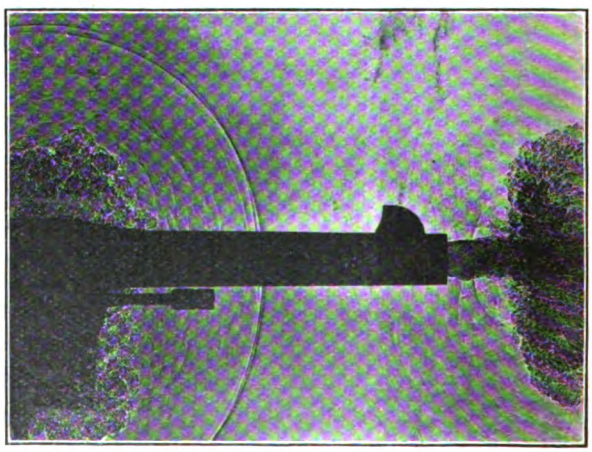


Fig. 8. Characteristic curves of tinstone. The two curves are obtained by applying the current in either direction of the contact.

PHOTOGRAPHING SOUND WAVES.





[By Courtesy of the Royal Photographic Society.

The articles by Professor Mallett in this Journal draw the attention of the wireless experimenter to the properties of sound waves as propagated through the air. These remarkable photographs show the setting up of sound waves both around the barrel and chambers of a discharging revolver. The spontaneous expansion necessary to expel the bullet creates considerable compression of the air in the form of a sphere which travels outwards owing to the air's elasticity. The wave of compression can be photographed owing to the change in the refractive index of the air when subjected to such great pressure.

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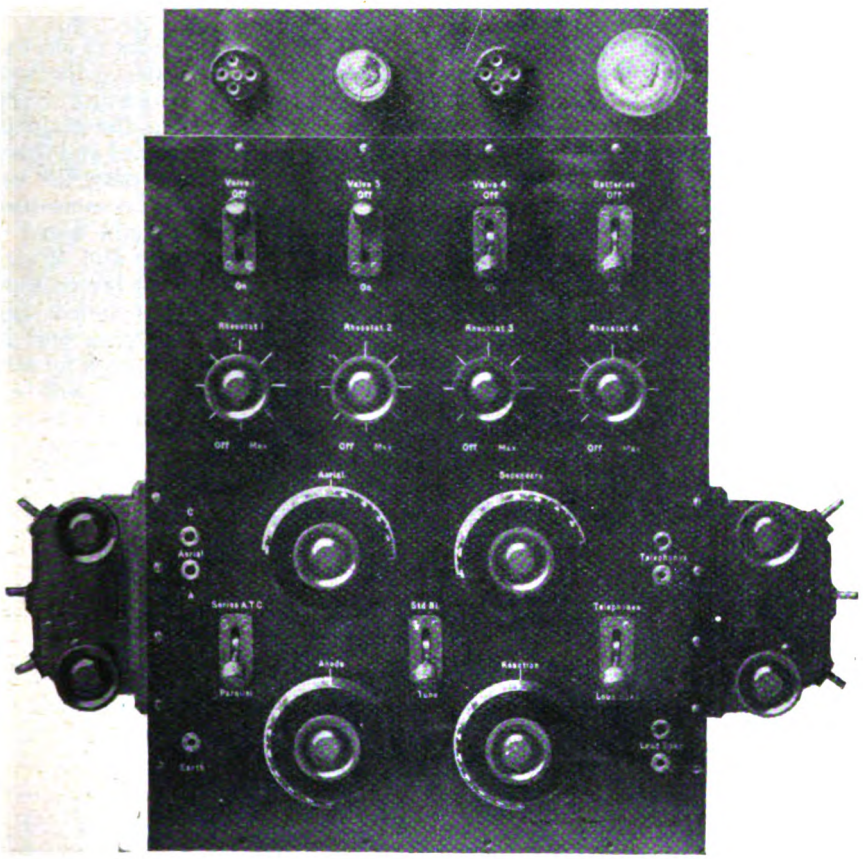
THE ALL PURPOSE RECEIVER.



The finished receiver.

Although requiring time and patience to construct, this receiver can be said to represent the ultimate design arrived at by the man who builds his own apparatus. While fairly simple to operate, it provides a large variety of circuit arrangements and will tune from 150 metres up to the highest wavelengths.

By W. R. Clark.

THE need for a receiver capable of working at extreme range when required, and on all wavelengths was the reason why the construction of a four-valve set with switching to give changes in the circuit arrangements was undertaken. Although it may be said that a complicated set of this sort involves an enormous amount of work, one is correct in saying that a design such as described in this article is the ultimate one which is generally arrived at by the man who constructs his own apparatus. Nowadays a receiver is not really the property of the experimenter, but usually belongs to the household as a whole and consequently

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simple operation must be possible. In one instrument it is possible to obtain a good variety of circuit arrangements with efficiency and the switches can be set to give simple operation if required.

Fig. 1 gives the theoretical circuit of the instrument and it will be seen to comprise one stage of high frequency amplification employing tuned anode coupling, followed by a detector valve and two stages of low frequency amplification, and provision is made on the last valve to use it as a power amplifier with grid cells and additional high tension potential. The circuit, as a whole, follows orthodox lines, and the writer, after considerable experiment with reflex and dual circuits, came to the conclusion that while these arrangements may possess particular merit to suit certain requirements, that on the whole and for " general purpose " reception, there is nothing better than a good straight circuit.

into operation the amplifying circuits, and in addition a switch is used for disconnecting the batteries. This latter switch permits of the receiver being left permanently adjusted to a particular station and switched on and off by anyone.

The front panel measures 16 ins. by 12½ ins. and is 5/16 in. in thickness, the valve platform being 3½ ins. in width. The valve platform is attached to the main panel by means of a hard wood board and this arrangement has the advantage that the valves are well protected and at the same time easily accessible. The hard wood board may, of course, be coated with dull drying black enamel or finished off to match the cabinet work. The board is, of course 12½ ins. in length by ½ in. in thickness, and if 4¼ ins. in width will give ample depth for the valves.

From the illustrations it will be noticed that the appearance of screw heads on the face of the panel has been avoided as far as

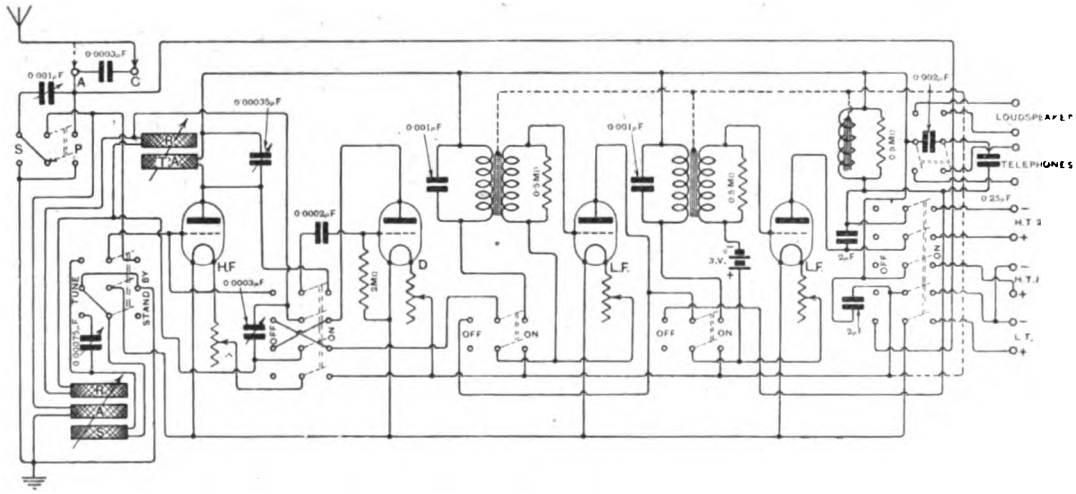

Fig. 1. Theoretical diagram of the All Purpose Receiver. It will be seen to comprise one stage of H.F. amplification, followed by a detector valve and two stages of L.F. magnification. A master switch entirely disconnects the batteries, while this one switch can be used for bringing the set into operation, when left tuned to the desired station.

Although in this article complete details will be found for carrying out the wiring up as shown in Fig. 1, the writer puts forward this description as it probably contains suggestions useful to other experimenters. It is rarely found that any constructional article is implicitly followed and the reader usually lifts ideas and adapts them to his own requirements.

Switches of the low capacity type bring

possible, and this has necessitated in a few instances the use of tapped blind holes. For securing the transformers, however, an additional platform is mounted so that 4 B.A. nuts and bolts can be used to support their comparatively heavy weight. Such blind holes as are required are made by using a short piece of drill in the drill chuck, which projects just sufficiently far to drill to the required depth. In passing it might

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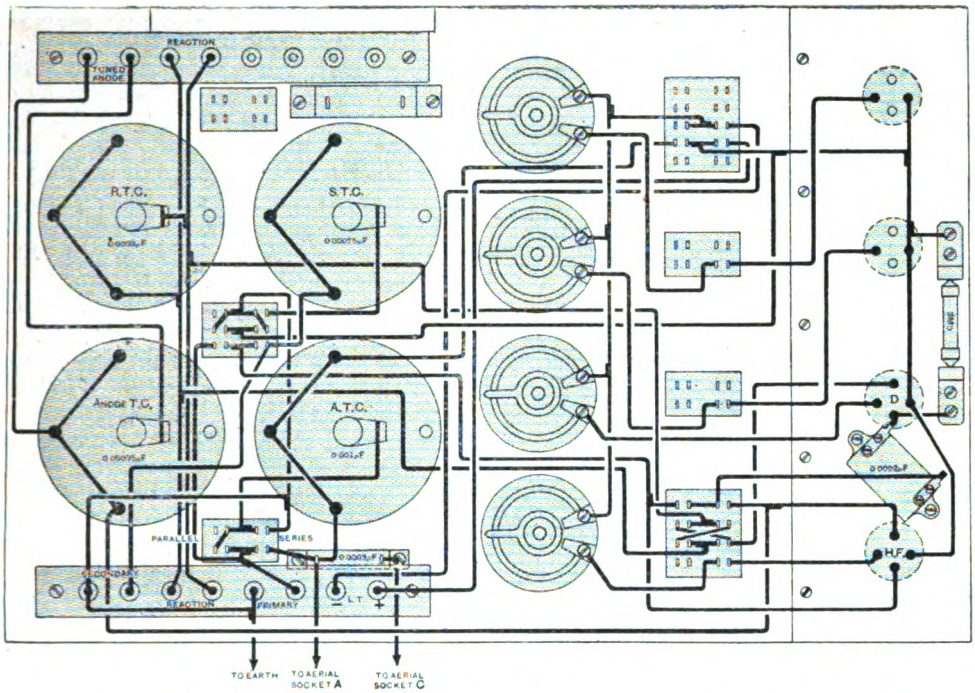

Fig. 2. Wiring of the aerial circuit, H.F. and detector valves and all filament leads.

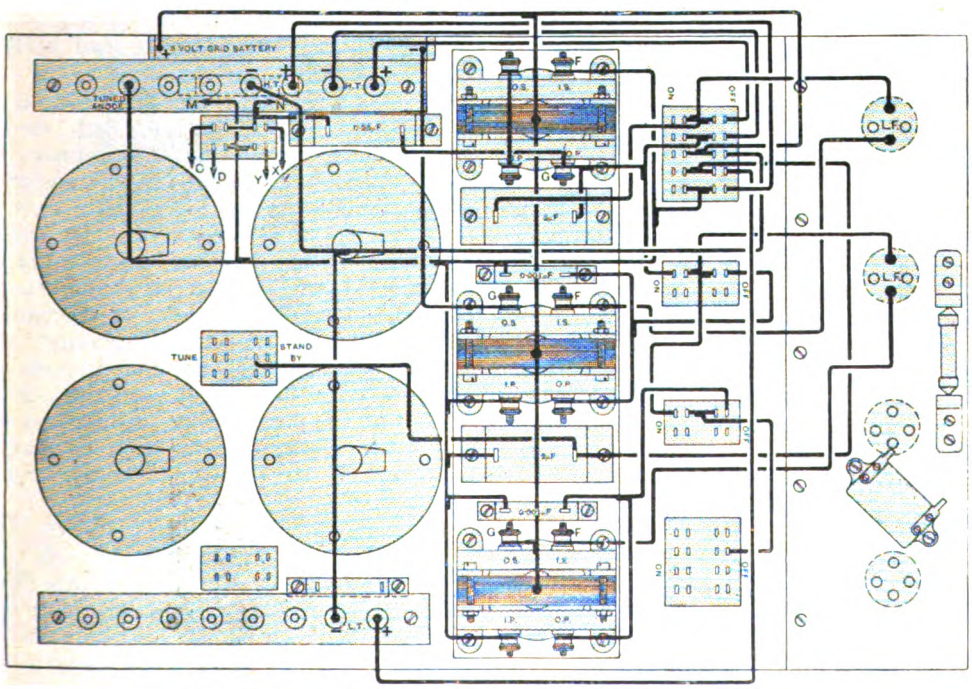

Fig. 3. The leads for wiring up the L.F. amplifying circuits.

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be mentioned that all blind holes are 7/64 in. in diameter and take $\frac{1}{8}$ in. Whitworth brass screws without the necessity of actually tapping out the holes after drilling.

The ebonite platform which carries the three transformers is also used to give support to the 2 mfds. H.T. battery bridging condensers and two 0·002 mfd. condensers. The platform is supported by six pieces of ebonite rod $1\frac{1}{2}$ ins. in length and $\frac{1}{2}$ in. in diameter. These rods are attached to the panel by means of short pieces of 4 B.A. threaded brass and attention might be drawn to the necessity of carefully squaring up the ends of these pieces and at the same time adjusting them all to be exactly equal in length.

Referring again to the front view of the set, it will be seen that aerial, earth, telephone and loud speaker connections are made by means of plug and socket connectors. These are of the "Gecophone" type and must be inserted in position before any of the other components are assembled. The sockets are driven home by means of a hammer and a block of wood into a 5/16 in. hole. Since it is not desirable for battery terminals to appear on the face of the panel, terminal strips are fitted up at the back and are clearly shown in the view of the back of the instrument. These strips are supported in precisely the same manner as the transformer platform.

The two coil holders on either side of the panel are carried on suitable blocks of wood, measuring $5\frac{5}{8}$ ins. by $3\frac{1}{4}$ ins. by $\frac{1}{2}$ in. in thickness. These wooden blocks are secured to the front panel by means of raised headed screws. The actual fixing of the coil holders to the main panel was not carried out until the wiring had been completed.

The three-cell grid battery used for biassing the grid of the power valve is a pocket torch refill measuring approximately 4 ins. in length and $\frac{3}{8}$ in. in diameter. It is held in place on one of the terminal strips by mounting between two brass clips.

It is the wiring up of a complicated receiver that often proves so difficult to the inexperienced instrument maker, and the theory circuit is interpreted in practical form in Figs. 2 and 3. Fig. 2 shows the wiring of the aerial circuit, the high frequency and detector valves and all of the filament leads, while Fig. 3 shows the wiring up of the two low frequency amplifiers. The points marked X and Y are connected to the loud speaker sockets on the front of the panel and C and D are connected to the telephone sockets. N and M are joined to the small fixed condenser mounted on the underside of the H.T. battery terminal strip. The terminals F and G are fitted with clips so that leak resistances having a value of 0·5 megohm may be fitted across the secondary windings of the transformers. The wiring up is carried out entirely with No. 16 tinned copper wire, perfectly straightened by stretching, and all joints are soldered. The filament resistances should be wired up first or otherwise it may be found a matter of difficulty when other sections of the wiring have been fitted. The aerial, earth, telephone and loud speaker sockets are wired next and also the 0·0003 mfd. condenser which is connected to the aerial circuit between the sockets C and A. The telephone condenser of capacity 0·002 mfd. is attached to the underside of the main ebonite panel directly below the left-hand terminal strip (rear view) and is connected across the two centre contacts of the telephone and loud speaker switch. The leads from the L.T. battery terminals on the right-hand terminal strip are run side by side in sleeving to the master switch and are raised away from the rest of the wiring. Included in the wiring is the lead bridging the cores of the transformers.

The primaries of the first and second transformers are usually bridged with the 0·5 megohm leak resistances. The primary and secondary windings of the third transformer are connected in series for use as a choke in the loud speaker feed circuit. It will be evident from the diagrams that reaction can be applied to either the aerial or anode inductances, the reaction sockets of the two coil holders being wired across in parallel. The bottom coil holder on the tuned anode side is again wired in parallel with the reaction leads, but the flexible wires are crossed over so as to reverse the direction of reaction coupling on to the tuned anode coil if required.

In operation the instrument fills the want for which it was designed. It will tune down to 150 metres, whilst on the other hand it will bring in transmissions on the longest wavelengths, such as the Bordeaux station. The broadcasting station **2 BD** is exactly one mile from the receiving aerial and by switching into service the tuned closed circuit, its

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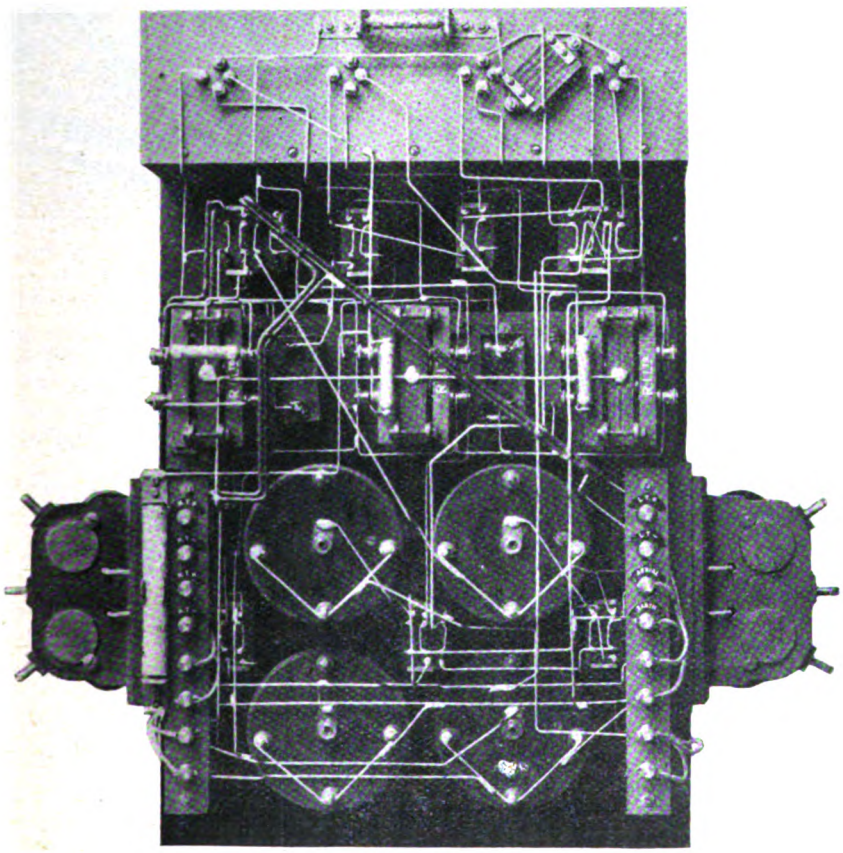
signals can be completely eliminated ; then by carefully tuning, Newcastle can be received on the loud speaker without a trace of the former station. No wave trap is employed, as loose coupling is, of course, far more effective, and the writer recommends the use of a loose-coupled receiver for the elimination of interference, though, of course, some practice is required in order to be able to tune two circuits simultaneously. **5XX** comes in well on the loud speaker with the last low frequency valve out of operation. Fairly good reception can be obtained after dark from Bournemouth, Cardiff and London and it is rather strange that in Aberdeen it is found more difficult to receive Manchester, Birmingham and Glasgow ; it is probable, in fact, that Glasgow is the most difficult station from which to obtain even satisfactory headphone reception. Most of the Continental stations come in well and give good loud speaker signals, even during daylight when using the four valves.

It might be mentioned that the set is housed in a mahogany cabinet which stands



A rear view of the panel.

4½ ft. high and has an overall length of 3½ ft., measuring 15 ins. from front to rear. Two side compartments are fitted with false backs behind which the low and high tension batteries are fitted.

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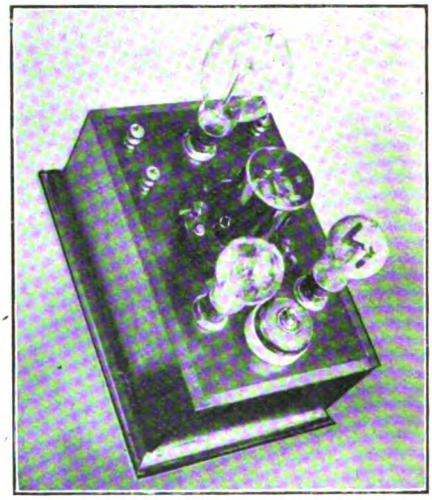
THE WIRELESS ARCHIVE

RECTIFIER FOR H.T. SUPPLY.

The instrument here described represents something new in rectifier design. A polarised relay is employed to suitably interrupt the supply, while neon lamps are introduced to regulate the output. For moderate voltages this instrument possesses great advantages over the usual thermionic or rotary type rectifiers. The connections are so arranged that D.C. voltages up to 500 can be obtained from the 200 volt A.C. mains without the use of a transformer.

By S. O. PEARSON, B.Sc., A.M.I.E.E.



The complete rectifier.

SOME time ago the writer had occasion to construct an instrument for supplying direct current at a pressure of approximately 350 volts for the purpose of a demonstration in a hall where no direct current was available, the electric supply being A.C. at a pressure of 200 volts. The arrangement appeared to work so well that it was decided to try it out as a means of supplying the H.T. current for a 10-watt valve transmitter. The results obtained were very satisfactory considering the simplicity of the apparatus.

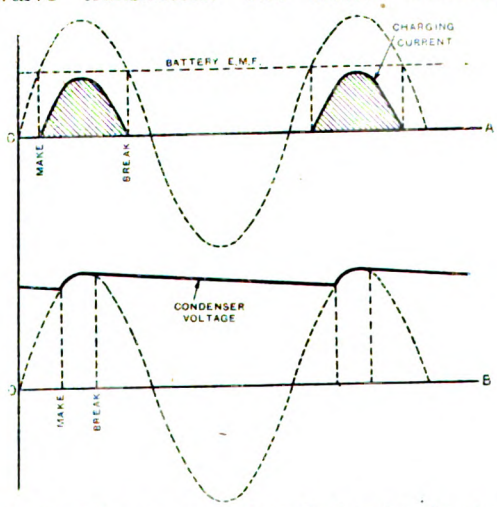


Fig. 1. The upper curve shows the duration of contact required with a vibrating contact rectifier when used for battery charging. In the lower curve the duration of contact is shown for a rectifier used for charging a condenser for plate current supply.

The rectifier operates on the principle of the synchronous vibrating contact-maker as often used for charging accumulators, various forms of which have been described in this journal. The conditions to be fulfilled for supplying H.T. are somewhat different from those obtaining in an ordinary rectifier for charging batteries, namely, that contact must be made for a very short period only, during the time that the supply E.M.F. is passing through its highest values. For accumulator charging at low voltages the contact must be closed during the major portion of each half wave. The difference can be easily seen by reference to the diagrams of Fig. 1, where half-wave rectification only is shown for clearness.

In the case of the battery charger we require a relatively large average current at low voltage and since the contact must be opened and closed at the times when the instantaneous values of the alternating E.M.F. are just equal to the back E.M.F. of the battery (in order to prevent sparking) it follows that the R.M.S. or effective value of the alternating voltage must be at least twice as great as the battery voltage if the period of closed contact is to last during the greater part of the half wave. In the case of the rectifier for supplying H.T., however, we require a small current only and as high an average value of E.M.F. as possible, and thus

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contact must be made only during the time when the alternating E.M.F. is passing through its highest values. This means that the ratio of "make" to "break" will be quite a small fraction, of the order of one-third of the half wave, or one-sixth when taken over the whole cycle, where half-wave rectification only is obtained. Hence to get an average steady current of 30 milliamps on the D.C. side, the average current drawn from the supply during one period of contact would have to be $30 \times 6 = 180$ milliamps. From this it follows that some means must be provided for storing the energy of each impulse of current, and capable of giving it out again at a steady rate. This can be effected by means of a condenser of large capacity, which is charged up by the current pulsations from the rectifier and kept charged. A simple arrangement of this nature is shown in Fig. 2, and needs no further explanation.

If no current were drawn from the condenser the voltage across it would build up until it became approximately equal to the peak value of the E.M.F. wave and practically no current would flow through the contact of the vibrator. If now a small steady current is drawn from the condenser, some of the charge will be gradually lost during the period of open contact and the voltage would fall at a rate depending on the capacity of the condenser, the rate of fall for a given current being inversely proportional to the capacity of the condenser. When

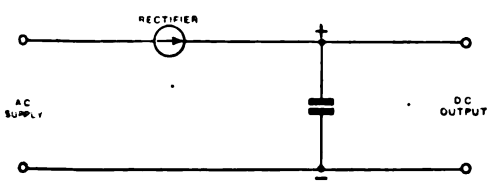

Fig. 2. The rectifier closes the circuit at peak voltage and maintains an almost constant potential across the large capacity condenser.

contact is made again the voltage of the condenser is raised to its full value once more and so the process repeats itself. The full line of Fig. 1 (*b*) shows how the voltage across the condenser would vary under these conditions. The larger the capacity of the condenser the less would be the cyclic variation of voltage, but in practice a condenser sufficiently large to suppress all A.C. hum would be too bulky and expensive, so that a special smoothing circuit consisting of a combination of chokes and condensers is connected between the rectifier and the valves. Smoothing is also very much facilitated by using full-wave rectification, *i.e.*, by utilising both halves of the A.C. wave and thus doubling the frequency of the pulsations.

In the instrument described below, full-wave rectification is employed and the connections are so arranged that D.C. voltages up to 500 can be obtained from the 200-volt A.C. mains *without the use of a transformer.*

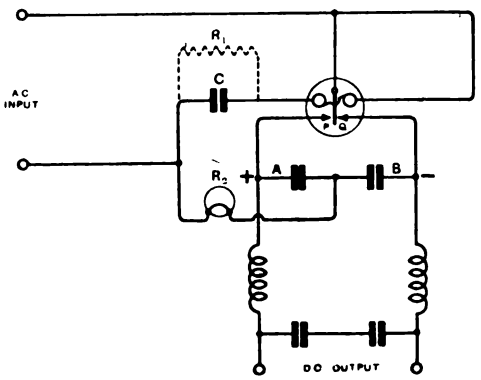

Fig. 3. Connections of full wave vibrator rectifier, employing a polarised relay.

The diagram of connections is shown in Fig. 3. The chief part of the rectifier, namely, the polarised vibrator and energising coils, consists of an ordinary Post Office recording relay, the one actually used being of the rocking armature type, as shown in Fig. 4, but no doubt any type of high speed recording relay would work equally well provided the insulation is sufficiently good to stand the high voltages. The coils, which each had a resistance of 500 ohms, were connected in series and supplied with A.C., which caused the armature to vibrate against the contacts at the same frequency as that of the supply.

In any synchronous rectifier where a vibrating contact-maker is employed it is essential that the vibrating member shall have the correct phase relation to the voltage of supply. In this case contact must be made just before the peak value of the voltage is reached and broken just after. Thus, assuming for the present that the armature responds perfectly to the magnetic pull of the coils, *i.e.*, that there is no mechanical lag due to inertia, it follows that the magnetic field, and thus the current through the coils, must be exactly in phase with the

C

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supply voltage. But actually the inertia of the moving part causes a mechanical lag (unless the armature constitutes a tuned reed, which is not the case here), and therefore to compensate for this the current through the energising coils should reach its maximum value some time before the voltage reaches its peak value, *i.e.*, the current should be made to lead the voltage by a certain phase angle.

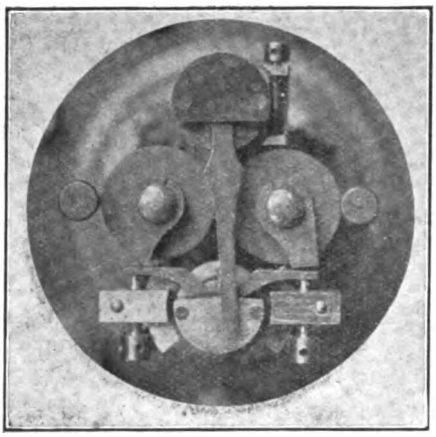

Fig. 4. The movement of a Post Office pattern relay used in the construction of the rectifier.

If one complete cycle or wave represents 360 electrical degrees, then, in any coil possessing resistance R and inductance L, the current wave will lag behind the impressed E.M.F. wave by an angle ϕ electrical degrees, where $\tan \phi = 2\pi f L/R$, f being the frequency. Thus if the relay coils were connected directly to the supply the contacts would be made, not near the peaks of the E.M.F. waves as required, but a considerable fraction of a period later, this fraction being $\phi/360$, on the assumption of no mechanical lag. Taking into account the mechanical lag, the instant of make would be still later. Thus a compensating device to correct the phase of the current must be employed and this usually consists of a condenser C (Fig. 3) shunted by a resistance R_1 and connected in series with the relay coils. When allowance is made for the mechanical lag, of the armature the current must be made to lead the supply voltage by a considerable angle, and since this varies for different relays, the correct values for C and R_1 must be found by trial. It must be borne in mind that this is a circuit partly tuned to the supply frequency and will probably pass too heavy a current if the full mains voltage is applied to its ends. Adding resistance in series to limit the current will necessitate a re-adjustment of the capacity, so that on the whole this system is rather complicated. The writer found that the mechanical lag was so large that the current had to lead the voltage by nearly a quarter of a cycle and this was effected quite easily by connecting a small condenser of about 0·25 mfd. capacity in series with the relay coils instead of the shunted condenser shown in Fig. 3. This small capacity had the additional effect of limiting the current through the relay coils so that the full 200 volts could be applied without overheating or over-magnetising the relay. Fig. 5 shows the vector diagram for this arrangement, where V = the voltage of supply (200), V_1 = voltage across the condenser, V_2 = voltage across relay and I = current through relay.

We come now to consider the operation of the device. It will be noticed from Fig. 3 that the vibrating armature is connected directly to one of the supply mains and that the two contact stops, P and Q, are connected across two 3 microfarad condensers A and B in series. The other main is joined through a lamp R_2 to the mid-point between the two condensers. When the relay is excited the armature vibrates against the contacts P and Q at the same frequency as that of the supply. Suppose that each time

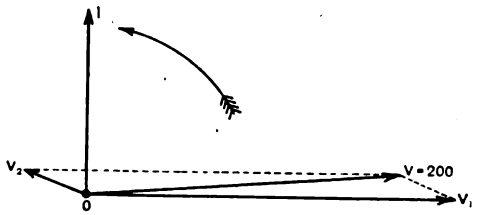

Fig. 5. Vector diagram showing the voltage displacement.

the alternating voltage is passing through its positive half wave, the left-hand contact closes just before the peak value, and that the right-hand contact does exactly the same for each negative half wave; then each of the condensers A and B will be charged up through the lamp R_2 to a voltage approximating to the maximum or peak value of the alternating E.M.F. wave and the polarity

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of each will be as shown by the signs + and − in the figure. Thus the voltage obtained across the two condensers in series will be nearly *twice* the maximum value of the alternating voltage. For a 200-volt circuit the peak value is $200 \times \sqrt{2} = 281$ volts, and therefore the theoretical maximum value of the D.C. voltage which could be obtained would be 281 across each condenser, or 562 volts across the two condensers in series. Actually on open circuit, *i.e.*, without drawing any D.C., the voltage was found to be about 520. A load of 20 milliamperes drawn directly from the condensers A and B caused the voltage to drop to about 450 (average value). Obviously by using larger reservoir condensers this drop could be considerably reduced.

The voltage across A and B was not sufficiently smooth for use on a telephony transmitter so that the smoothing chokes and condensers shown in the figure had to be employed. The only chokes available at the time of the experiments had a fairly high ohmic resistance, with the result that, with a current of 20 m.a., there was a drop in voltage of about 100, bringing the useful output pressure down to 350 volts practically free from A.C. hum. By using low resistance chokes and large reservoir condensers a useful working voltage well over 450 volts could easily be maintained.

The lamp R_2 is included to prevent sudden rushes of charging current into the condensers A and B, as this would cause welding of the contacts and sticking. The lamp should not have too high a resistance; one rated at 200v. 100 watts was found suitable. A lamp is used rather than an ordinary resistance because with its use there is no possibility of burning it out or doing other damage should the contacts become short-circuited, as might easily occur whilst making adjustments with a metal screwdriver.

It should be noted that the two condensers A and B have their charges replenished alternately from the respective half waves of the supply so that we have full-wave rectification, and the frequency of the A.C. hum, if any, in the transmitter, will be twice that of the supply, *e.g.*, 100 cycles per second from a 50 cycle supply. Since the supply system is earthed, the necessary precautions must be taken to prevent a short circuit to earth on the D.C. side; either a counterpoise should be used instead of the usual "earth," or, if the latter is used, a condenser of good insulation should be connected in the earth lead. The *earthed main* should be connected to the mid-point between the reservoir condensers A and B, so that the output terminals of the rectifier have equal potentials above and below that of the earth, thus greatly reducing the possibility of severe shock by accidental contact between any part of the system and earth.

A relay of the type employed here is usually very carefully constructed and the various parts are well insulated with good ebonite bushes, etc. The author has experienced no trouble of the nature of a breakdown of insulation as might at first be expected, since such an instrument is really designed only for use on about 10 or 20 volts.

The complete instrument is shown on page 102. On the top of the panel are mounted the relay, the input and output terminals, the metal filament lamp (represented by R_2 in Fig. 3), and two neon lamps, the use of which is explained below. Inside the box are the reservoir condensers and the smoothing chokes and condensers.

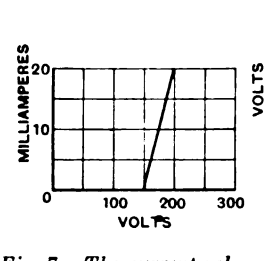

Fig. 7. The current-voltage characteristic of a neon lamp.

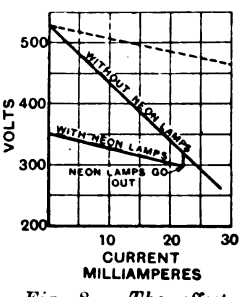

Fig. 8. The effect of employing neon lamps as regulators.

Thus the instrument comprises a complete unit for supplying high tension D.C. from the A.C. mains. It requires no accessories whatever, and for moderate voltages it possesses great advantages over the usual thermionic type of rectifier which requires a special transformer, filament heating batteries, etc., and over the rotary type of rectifier which requires a special synchronous motor. The energy losses are quite small, resulting in a very high efficiency.

The two neon lamps shown in the photograph are connected in series across the output terminals and have the effect of keeping the output voltage fairly constant

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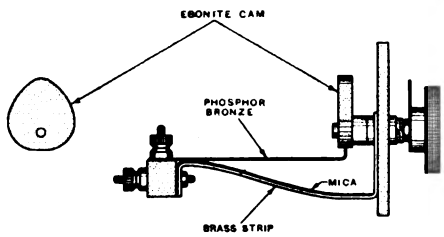
over a wide range of loads in spite of the fact that very high resistance chokes were used for smoothing purposes. A consideration of the current-voltage characteristic of a neon tube (Fig. 7) should make the reason for this quite clear. A small change in voltage across the neon lamp produces a relatively large change of current through the lamp and so the actual current flowing through the chokes is kept fairly constant for all outputs, resulting in a more or less steady terminal P.D. Since one neon lamp requires about 170 volts it was necessary to use two in series in order to get over 300 volts output. In order to get over 450 volts it is necessary to use large reservoir condensers, low resistance chokes, and three neon lamps in series across the output terminals.

The curves of Fig. 8 show the "regulation" of the instrument with and without the use of neon lamps respectively. When neon lamps are used in this way the contacts of the relay will work absolutely sparklessly, whether the instrument is on load or not, which is not the case if the neon lamps are omitted; there is a tendency to spark slightly when the load is completely removed. However, this may not occur if larger reservoir condensers are used and is a matter for further experiment.

AN EASILY MADE VARIABLE CONDENSER.

Variable condensers can now be purchased so cheaply that the experimenter rarely undertakes the making of this component himself, particularly as the usual design involves the accurate setting up of a spindle for the moving plates. On the score of cheapness alone, however, the condenser shown here warrants the attention of the amateur.

The constructional details are readily apparent from the accompanying drawing,



and the condenser will be seen to consist of very few parts, all of easy construction. The ebonite terminal piece is about ½ in. square by 1⅛ in. in length. The stiff brass piece is 1⅛ in. wide, and gives a spacing of about 3½ in. from the face of the panel. It is faced with a strip of mica, which for durability is about 0·006 in. in thickness, though it is not necessary, of course, for this dimension to be precisely as stated. The bearing and bush are parts easily procurable from dealers in wireless components, and the knob can be obtained fitted with a 2 B.A. nut. The ebonite cam which operates on the springy brass piece is heart-shaped, and can be designed to produce a true square law effect.

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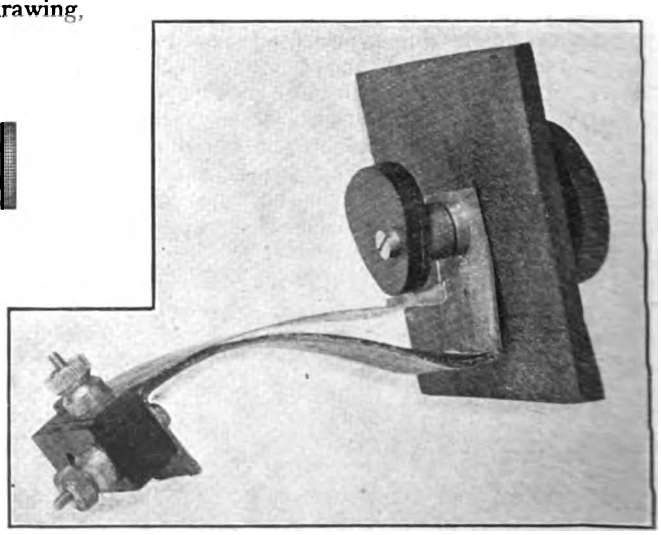

The spring piece is depressed into contact with the mica-faced support by the heart-shaped cam.

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VALVE TESTS.

THE COSSOR P.1 AND P.2 VALVES.

THIS week we deal with two Cossor products, the P.1 and P.2.

The appearance and method of assembly of these valves, with their hood-shaped anodes, is so well known as to need no further description here.

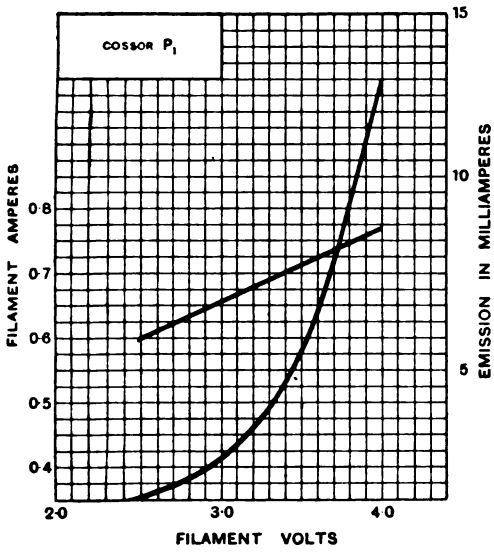

Fig. 1.

The P.2 is designed and recommended for high frequency work only, whereas the P.1 is intended for use as a detector and low frequency amplifier. Both types are fitted with similar filaments, rated at 3·5 to 4·0 volts, and for this reason the filament characteristics of Fig. 1 refer to both valves, for while tests were carried out on the two, the results were almost identical.

At 3·5 volts the filament emission is slightly below 5 milliamperes, rising to 13 milliamperes at the maximum rated voltage, so that at the latter value we have ample emission when using the valve as a low frequency amplifier.

The heating current varies roughly between 0·7 and 0·77 ampere.

Confining our attention firstly to the P.1, plate-current grid-volts curves are shown in Fig. 2, which suggest good low frequency amplification when using a plate potential of 80 volts, and a negative grid bias of 1·5 to 2·0 volts. The magnification and impedance curves are given in Fig. 3, from which we find their values to be around 8·5 and 25,000 ohms respectively at a plate potential of 80. The curves, however, suggest that

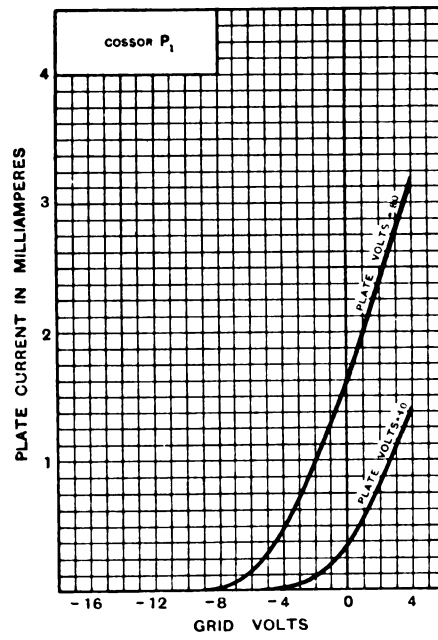

Fig. 2.

improvement might be effected by raising the plate potential to something over 100 volts, which would, of course, in addition, lengthen the operating region to the left of the zero grid volts line.

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Turning next to the P.2, to which, as we have already stated, Fig. 1 also refers, we come to the plate-current grid-volts curves of Fig. 4, which at once suggest a higher plate impedance than obtains with the P.1. This is confirmed by the impedance curve of Fig. 5, which shows an impedance of 35,000 ohms at a plate potential of 80, the magnification factor at the same point being 10.

Tested on our standard arrangement, the P.2, operating with a plate potential of 50, gave excellent results as a high frequency amplifier, and it was, moreover, found possible considerably to reduce the filament brilliancy without losing signal strength.

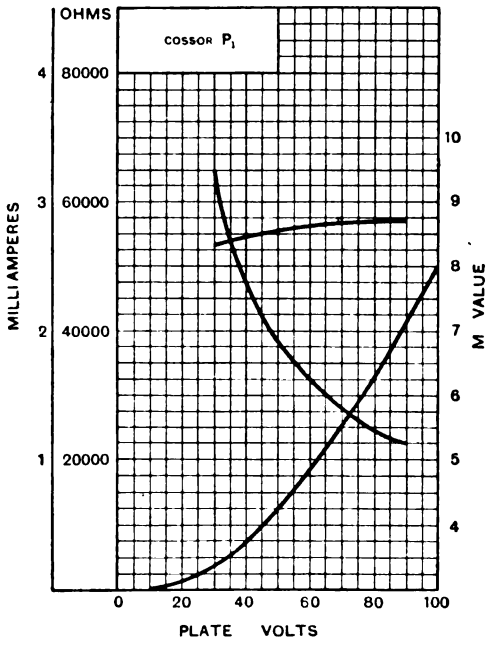

Fig. 3.

The P.1. was next tried, first as a detector, when about 40 volts plate potential appeared to be the most suitable. As a low frequency amplifier anything above 50 volts, according, of course, to the input, gave good results. With 100 volts plate potential, backed off with a grid bias of —3, plenty of signal strength was obtained and this was of excellent quality, but it is, of course, desirable to keep the filament volts up when using the higher plate potentials.

In short, these bright emitting valves are good specimens of their class, and can

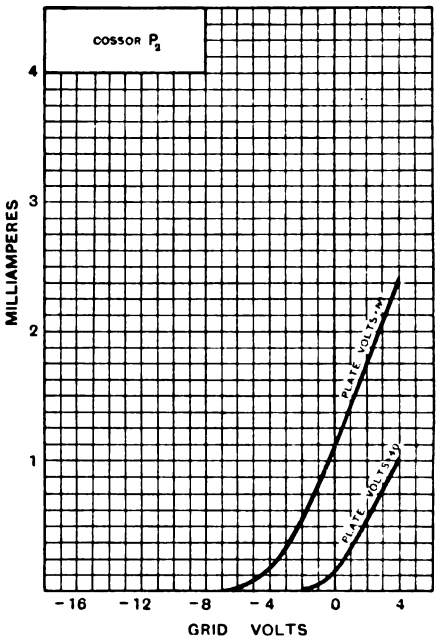

Fig. 4.

be recommended for the particular work for which they have been designed.

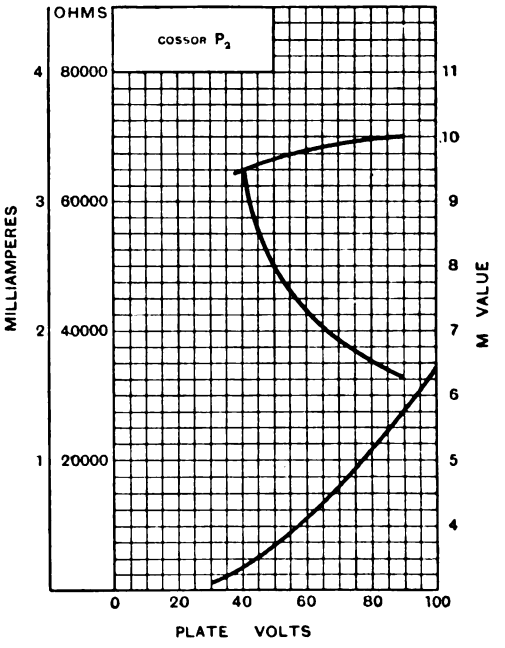

Fig. 5.

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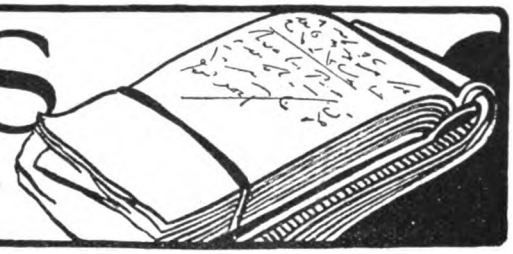
NOTES & NEWS



Milan is to be provided with a broadcasting station which, we understand, is now in process of erection. The wavelength is provisionally fixed at 650 metres.

* * * *

According to the latest statistics, there are now a quarter of a million receiving sets in use in Germany, 120,000 being licensed in Berlin alone.

* * * *

M. Belin, inventor of the telautograph, has accepted the honorary presidency of the Internacia Radio Asocio, which is the international radio Esperanto organisation.

* * * *

Open air radio concerts are finding favour in Moscow, where large crowds assemble nightly in the grounds of the "People's House," in which are placed seven large loud speakers.

* * * *

A company, backed by French interest, is to erect a broadcasting station in Poland.

* * * *

The "Petit Parisien" broadcasting station has reduced its wavelength to 340 metres.

* * * *

NEW ZEALAND AMATEUR HEARD IN BRITAIN.

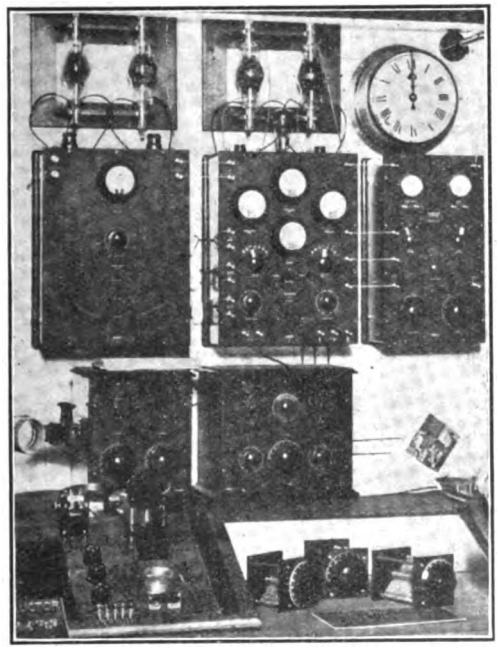
Subject to confirmation, which is almost certain, the world record for amateur wireless communication was created on Thursday, October 16th, when New Zealand 4 AG was heard in England by Mr. E. J. Simmonds (2 OD) of Gerrard's Cross, Bucks.

Listening-in on a wavelength of about 80 metres at 6.30 a.m. Mr. Simmonds picked up clear signals from the New Zealander, who worked first with American 5 MI and later with American 6 ARB.

Prior to this 5MI had sent out a CQ, prefixing his call with the code word ALABAMA, to which 4 AG replied.

Corroborative evidence is also afforded by the current issue of *Q.S.T.*, in which 6 ARB is described as one of the American amateurs in regular touch with New Zealand.

The distance covered by this remarkable transmission is approximately 11,500 miles. Mr. Simmonds, who was using a super-heterodyne receiver, reports that 4 AG transmitted with a low A.C. note.



A complete transmitting and receiving plant for telegraphy and telephony which formed an attractive item on the stand of Messrs. Burndept, Ltd., at the All-British Wireless Exhibition.

44-METRE WORKING WITH U.S.

M. Pierre Louis (8 BF), is now operating on 44 metres and has already worked successfully with U.S. amateurs, at Philadelphia and Fall River. He has been reported in America at "'phones-on-the-table" strength, with a two-valve set.

ROME BROADCASTING.

A definite programme of transmissions has now been adopted by the Rome broadcasting station, which has been allotted the call sign of 1 RO. Transmissions now take place nightly from 7.30 to 9.30 G.M.T., on a wavelength of 422 metres.

The station announcement is: "Stazione di Roma — Unione Radiofonica Italiana."

FREE STATE'S BROADCASTING SCHEMES.

The statement that 150,000 licensed listeners-in can be found in the Free State to defray the expense of a broadcasting station was characterised by the Secretary of the Irish G.P.O. as "sheer nonsense."

It will be remembered that the Dail decided against private ownership of broadcasting stations. Unless, therefore, the Ministry of Finance decides to expend public money, such stations cannot be established. Should plans materialise, the proposed site of the first station is Phœnix Park, Dublin.

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FRENCH DEMAND FOR REGIONAL BROADCASTING.

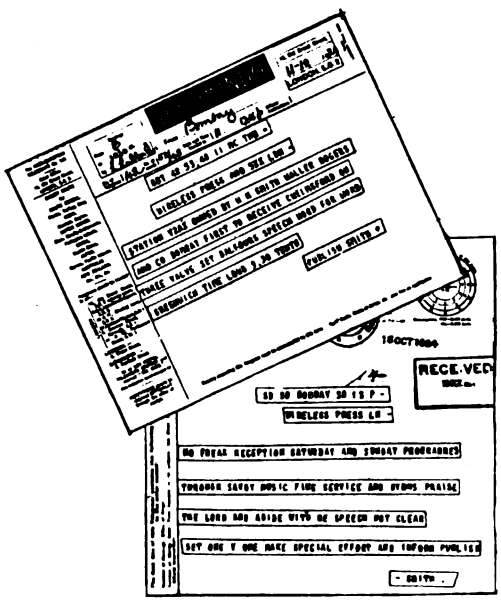
An appeal for a system of broadcasting to provide an adequate service for all parts of France, is made in the October issue of *La T.S.F. Moderne.* At present the principal broadcasting stations are situated in Paris, which is not in the centre of the country. The erection of one powerful main station has been proposed, but our contemporary points out that France is too large to permit of such a scheme. Under the present conditions, amateurs in three quarters of the country are disinherited. To obtain broadcast reception they must spend a small fortune, and are happy if they get any results at all.

In conclusion, the authorities are urged to emulate the example of Great Britain. French amateurs are now waiting, but at the moment they see nothing. And thus, sighs our contemporary, the 1924-1925 season will pass like its predecessors.

CIRCUIT INVENTOR'S LOVING CUP.

Some interesting awards have been made in the competitions held in connection with the Radio World's Fair, which closed on September 28th after a successful week at the Madison Square Garden, New York.

For the "Originality and Perfection" of his new circuit, Mr. E. T. Flewelling received a silver loving cup. Similar presentations were made to Mr. Herbert Frost for the successful adaption of Bakelite to loud speaker manufacture, to Mrs. Frank L. Savage for her "Portable Antenna," and other competitors.



Proof of the world-wide efficiency of **5XX** *is furnished by the above telegrams which have been sent to us by a Bombay reader.*

FRENCH 8 AB ACTIVE.

Many readers are no doubt aware that M. Leon Déloy (**8 AB**), the well-known pioneer of short wave transatlantic working, has returned to Nice and is again using his characteristic 25-cycle transmission on 95 metres. Mr. W. K. Alford, of Camberley, Surrey, reports signals of "terrific strength" from the French veteran while using a superheterodyne. The station was still audible without heterodyning.

THAT EARTH CONNECTION.

"I believe the earth connection is more important than anything else, but few people are able to get a good one," said Mr. H. R. Rivers-Moore, B.Sc., giving the R.S.G.B. talk from **2 LO** on October 16th. "At sea, where the earth is made by the huge hull of a vessel immersed in salt water, I have easily heard B.B.C. stations with a crystal set and small aerial at ranges of several hundred miles. If," he continued, "it were possible to bury the 'Mauretania' in the backyard, the results would, I believe, astonish you."

Mr. Rivers-Moore then hinted at the fascinating experiments which could be conducted with crystals used to amplify and oscillate. The purchase of a small battery would enable the experimenter to start at once and the speaker referred to the circuits given in *The Wireless World and Radio Review* of October 1st and 8th. In view of these developments the crystal user could feel not only that his field of experiment was greatly widened, but that he was in the forefront of research once more, and in a position to contribute really valuable information.

HONOLULU CALLING.

M. J. L. Menars, **8 FS**, who is rapidly becoming one of the foremost of French amateurs, informs us that on October 8th, at 5.30 a.m., he heard Hawaiian **6 CEU** transmitting a CQ call on about 80 metres. The strength of the signals was R4 with a three-valve receiver.

The distance between Honolulu and M. Menar's station at Le Blancat, near the Pyrenees, is approximately 9,500 miles.

THE AMPLION "DRAGONFLY."

Messrs. Alfred Graham & Co. ask us to draw attention to mistakes which occurred in the advertisement of the Amplion "Dragonfly" appearing on page xxvi of our issue of October 15th. The dimensions of the instrument should have been given as follows: Diameter of trumpet, 5½ ins.; overall height, 9 ins.

The address of the Company is St. Andrew's Works, Crofton Park, London, S.E.4.

FREEDOM FOR JAPANESE AMATEURS.

For some months Japanese amateurs have been waging war with certain authorities who have endeavoured to curtail freedom of reception under the pretext of securing secrecy for official messages.

An official regulation has been issued, however, allowing greater freedom for amateurs, and wireless traders are now preparing a vigorous campaign.

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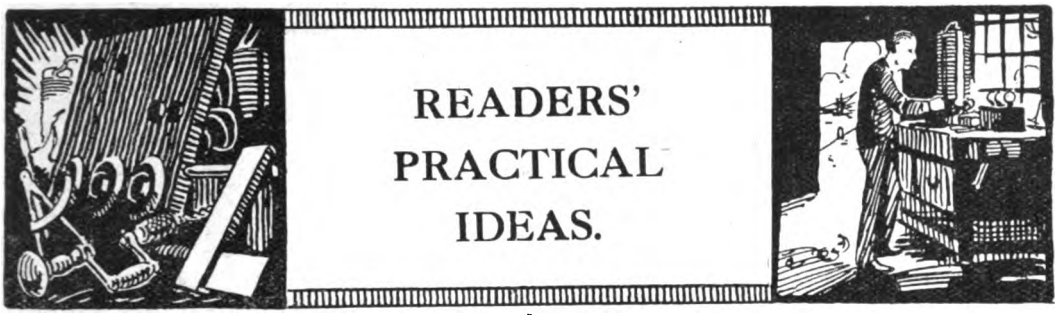
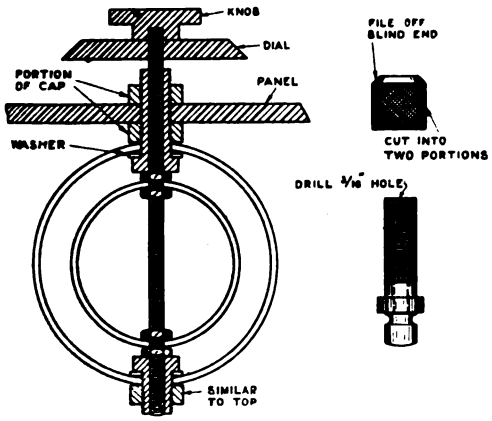


This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

One-hole Fixing for Variometers.

THE ordinary motor car tyre valve body and cap makes a very useful fitting for securing a variometer to the instrument panel, and at the same time serving as a bearing to the spindle. It is only necessary to drill a $\frac{5}{16}$ in. hole down the centre of the plug and cut off the small end. The valve cap should be cut into two pieces after filing off the blind end, so as to form two nuts. The actual method of fitting up is shown in the drawing, from which it will be seen that a 2 B.A. rod serves as a centre spindle, making a good fit in the $\frac{3}{16}$ in. hole.

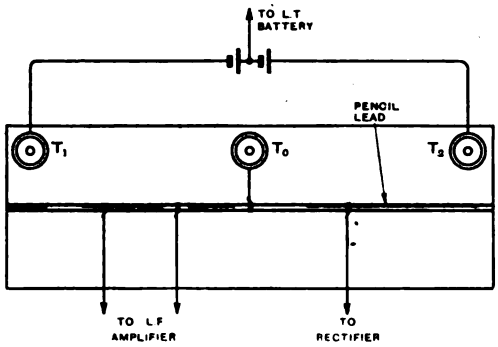
J. L.



Using motor tyre valve parts in variometer construction.

Regulating the Grid Potential.

THERE are many types of valves available for use in the various circuits of a multi-valve receiver. It is essential to carefully adjust the grid potential so that the valves are correctly operated. This can be effected both easily and inexpensively by making use of the lead removed from an



The lead removed from a pencil makes a good variometer.

"H" pencil and connected up as a potentiometer. The lead can be mounted up on a piece of ebonite to facilitate connection across it of two small cells by means of terminals T_1 and T_2. Terminal T_0 gives zero potential, whilst positive and negative biassing potentials may be picked up on either side of the zero.

A. L. B.

Compact High Efficiency Switch.

IN constructing switches for panel mounting, one must aim at producing a component that will occupy very little space and if to be connected in high frequency circuits, the switch parts must be small and present low capacity one to another. A switch of simple construction fulfilling these requirements is shown in the accompanying illustration, from which sufficient detail can almost be gathered for making it up.

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The base piece from which the contacts are assembled is 1½ ins. by 1½ ins. by ¼ in. and twelve small holes are drilled on a ¾ in. circle into which pieces of No. 20 copper wire are fitted. These pieces of wire are turned over on the other side of the panel, one being left projecting about ¾ in. so that it can be bent back for the purpose of making connection. The spindle is attached to the ebonite between two nuts and the nut on the underside locks up against the ebonite arm into which the spindle is

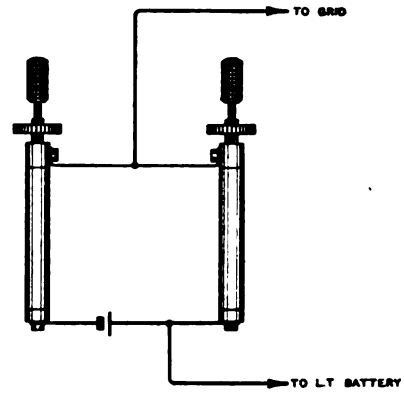
Compact double pole two-position switch suitable for use in high and low frequency circuits.

threaded. The arm is fitted with a pair of spring contacts which each bridge two of the wire contacts. These spring pieces are made from brass and attached to the arm by means of two 4 B.A. cheese headed screws. To restrict the movement of the switch a pair of ebonite pegs are driven into holes into which they fit tightly. The switch shown is a double pole change-over and can be made up at very little cost.

W. S. R.

Variable Grid Leaks as a Potentiometer.

IT is usually an advantage to fit a potentiometer between the earth end of the inductance and the filament circuit in the case of a high frequency amplifying valve. Quite a good potentiometer can be made up from two grid leaks. The two leak resistances are connected in series through a battery of one or two cells, the positive or negative of which is connected to the filament circuit, depending upon whether a positive or negative bias is needed. The other ends of the resistances are linked across and taken to the end of the coil which leads to the grid.



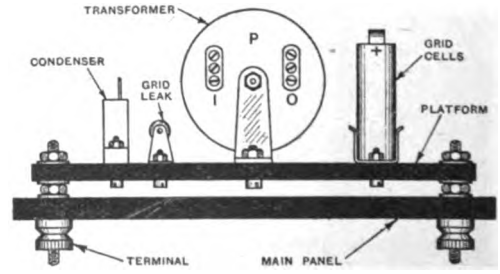
Two variable grid leaks connected up to form a grid potentiometer.

The potential is varied by increasing the value of one resistance and reducing the value of the other.

W. H. B.

A Sub-Panel to Avoid Screw Heads.

THOSE who construct their own sets and have particular regard for appearance, usually experience difficulty in devising a method for attaching the very many components to the panel and avoiding the appearance on the face of a large number of screw heads. One of the simplest methods of effecting this is to employ a sub-panel which gives the advantage of providing accommodation for many more components than can be carried by the front panel.



Method of avoiding the appearance of screw heads on the face of the instrument panel.

This additional panel may be secured by the stems of the terminals in the manner shown.

O. M. D.

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PATENTS AND ABSTRACTS

An Improved Generator of Oscillations.

It is well known that for the most efficient production of oscillations by a valve, it is essential that the anode currents through the valve vary from a minimum value in a sudden or impulsive manner. In this invention* oscillations are generated impulsively by the amplifier or power valve.

A highly negative polarising potential on the grid of the valve normally opposes the transmission of any substantial amount of anode current through the valve. The reaction coil coupled between the output and input circuits of the power valve includes a relay valve, the grid of which is provided with a highly negative polarising potential. Hence only the positive peaks of oscillations impressed thereon are effective in producing anode current in the output circuit of the auxiliary valve. The output current will therefore consist of sharp non-sinusoidal impulses of anode current, which are transmitted through the input coupling of the power valve, and cause the grid of the power valve periodically to become highly positive for extremely small intervals of time, thereby causing very sharp impulses of anode current to flow in the output circuit of the power valve. Hence oscillations are produced in the tuned circuit connected to the power valve.

By using a relatively high anode voltage, and a high grid polarising potential, a very high efficiency may be obtained in generating oscillations of the desired frequency. The excitation by a non-sinusoidal impulse permits the power valve to operate with a minimum or very small loss of electrical energy within the valve as compared to the energy delivered to the output circuit in the form of oscillations of the desired frequency.

Fig. 1 is a circuit diagram showing one arrangement with means for modulating the

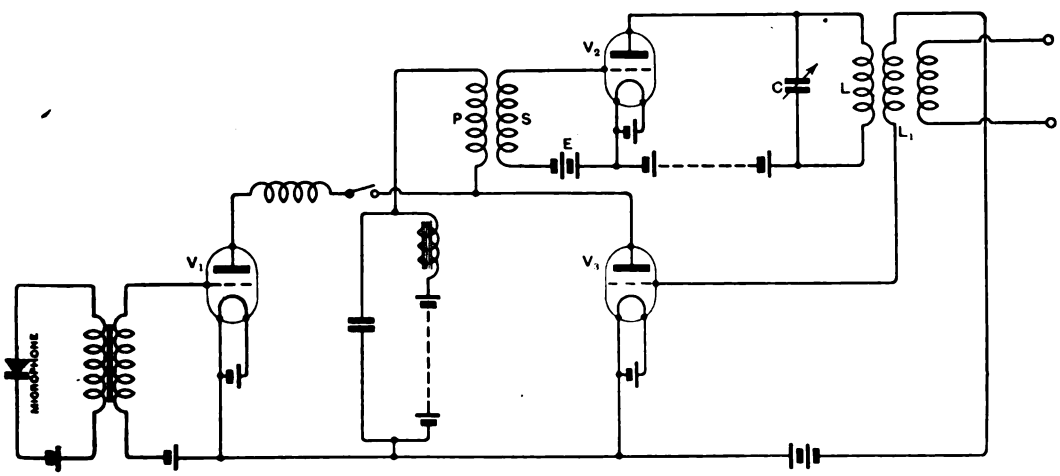

Fig. 1. The connections of an improved oscillator which is shown connected to a modulator.

* British Patent No. 213,562, by The Western Electric Company and H. W. Nicholls.

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oscillations. V_1 is the modulating valve, V_2 the power valve, and V_3 the auxiliary valve connected to the grid circuit of the power valve.

The operation of the circuit may be understood more clearly by referring to Figs. 2 and 3. In Fig. 2, the curve refers to the auxiliary valve, and shows the value of anode current, Ib_1, for the different values of grid potential, Ec_1.

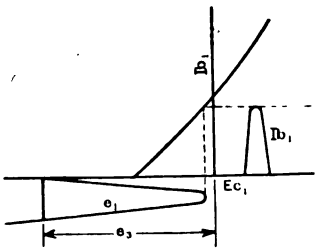

Fig. 2.

Assuming that circuit CL, Fig. 1, is tuned to the correct frequency, and oscillations are flowing in it, voltages will be induced in L_1, producing an alternating voltage which may be represented as e_1 (Fig. 2). The voltage e_1 produces a rapid increase in anode current, thus producing an impulse of current through the primary winding P of the input transformer. Since the grid of the auxiliary valve becomes positive only once during each cycle, there will be one impulse, Ib_1, for each cycle of the oscillations being generated.

The curve of Fig. 3 applies to the power valve, and shows the values of grid potential, Ec_2. The negative polarising potential of the grid battery E is represented as e_4. The voltage e_2 is that induced in the secondary winding S of the transformer, by the impulse passing through the primary winding. It will be noticed that the voltage e_2 applies a much sharper positive peak of potential to the grid of the power valve than the voltage e_1 applied to the grid of the auxiliary valve. As a result of this abrupt change in the voltage of the grid of V_2, a current impulse Ib_2 is transmitted through the output circuit of the power valve. The effect of these sharp impulses upon the tuned circuit CL is to set up and maintain in this circuit free oscillations of the natural frequency of the circuit.

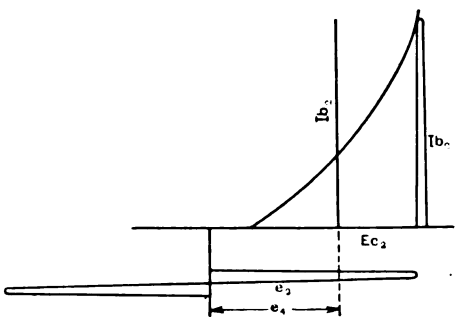

Fig. 3.

A Device for Giving Fine and Coarse Adjustments.

It is very helpful to employ variable condensers and variometers which may be adjusted exactly to the value required for best results.

Some tuning condensers have a single plate which may be turned without disturbing the main adjustment. Others are provided with a device which provides a quick and slow movement.

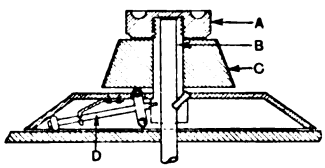

Fig. 4. A special device for giving fine adjustments.

The knob and dial* sketched in Fig. 4 may be secured to the shaft of a variable condenser or variometer to give it the desired close adjustment.

A is a knob which is screwed to a bush B, and the shaft of the instrument for coarse adjustment.

The knob C fits comparatively loosely over the bush B, and, when it is turned, moves the shaft D. The shaft D forms part of a reducing gear, as may be seen from the sketch. Hence, when knob B is turned, the shaft of the instrument is only slowly turned through the reduction gear, and provides the desired " vernier " adjustment.

W.J.

*British Patent No. 221,053, by C. H. Clarabut.

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BROADCASTING.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:

GREAT BRITAIN.

CHELMSFORD 5 XX, 1,600 metres, Tests. **ABERDEEN 2 BD**, 495 metres; **BIRMINGHAM 5 IT**, 475 metres; **BELFAST 2 BE**, 435 metres; **GLASGOW 5 SC**, 420 metres; **NEWCASTLE 5 NO**, 400 metres; **BOURNEMOUTH 6 BM**, 385 metres; **MANCHESTER 2 ZY**, 375 metres; **LONDON 2 LO**, 365 metres; **CARDIFF 5 WA**, 351 metres; **RELAY STATIONS**: **LEEDS-BRADFORD 2 LS**, 346 and 310 metres; **PLYMOUTH 5 PY**, 335 metres; **EDINBURGH 2 EH**, 225 metres; **NOTTINGHAM 5 NG**, 322 metres; **HULL 6 KH**, 320 metres; **LIVERPOOL 6 LV**, 315 metres; **SHEFFIELD 6 FL**, 301 metres. Tuesdays, Thursdays and Fridays, 1.0 p.m. to 2.0 p.m. (**2 LO** only). Regular daily programmes, 3.0 to 7.30 p.m., 8.0 to 11.30 p.m. Sundays, 3.0 to 5.0 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS ("**Radio Paris**"), **SFR**, 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.30 p.m., Exchange Prices; 4.30 p.m., Financial Report; 5.0 p.m., Concert; 8.30 p.m., News and Concert.

PARIS (Ecole Supérieure des Postes et Télégraphes), 450 metres. 3.45 p.m. (Wednesday), Talk on History; 8.0 p.m. (Tuesday) English Lesson; 8.30 p.m., Concert; 9.0 p.m., Relayed Concert or Play.

PARIS (Station du Petit Parisien), 340 metres; 8.30 p.m., Tests.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 2.0 p.m. and 6.50 p.m., Meteorological Forecast.

BRUSSELS ("**Radio-Belgique**"), 265 metres. Weekdays, 5.0 p.m. to 6.0 p.m., and 8.0 p.m. to 10.0 p.m.; Sunday, 5.0 p.m. to 6.0 p.m., and 8.30 p.m. to 10.0 p.m.

HOLLAND.

THE HAGUE, PCGG, 1,070 metres. 4.0 to 6.0 p.m. (Sunday), 9.40 to 11.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres. 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9.0 p.m. (Thursday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday, 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular). 8.40 to 10.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres, 9.0 a.m. and 5.0 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 8.30 to 9.45 p.m. (Weekdays), 8.0 to 9.0 (Sunday), Concert.

SWEDEN.

STOCKHOLM (Telegrafverket), 440 metres. Daily, 12.45 to 1.0 p.m., Weather Report and Nauen Time Signal; Monday, Wednesday and Saturday, 8.0 to 9.0 p.m., Concert and News; Sunday, 11.0 a.m. to 12.30 p.m., Divine Service from St. James' Church.

STOCKHOLM (Radiobolaget), 470 metres. Tuesday and Thursday, 8.0 to 9.30 p.m., Concert and News.

GOTHENBURG (Nya Varvet), 700 metres. Wednesday, 7.0 to 8.0 p.m.

BODEN, 2,800 metres. Tuesday and Friday, 6.30 to 7.30 p.m., Sunday, 5.30 to 6.30 p.m., Concert and News.

GERMANY.

BERLIN (Koenigswusterhausen), LP, 680 metres. Sunday, 10.50 to 11.50 a.m., Concert; 2,800 metres, Sunday, 11.50 a.m. to 12.50 p.m., Concert.

EBERSWALDE, 2,930 metres. Daily, 1.0 to 2.0 p.m., Address and Concert; 6.0 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (Vox Haus), 430 metres. 11.0 a.m., Stock Exchange; 1.55 p.m., Time Signals; 5.40 to 7.0 p.m., Concert; 7.0 to 8.0 p.m. (Sunday), Concert.

BRESLAU, 415 metres.
HAMBURG, 387 metres.
STUTTGART, 437 metres.
KONIGSBERG, 460 metres.

FRANKFURT-AM-MAIN, 467 metres. 7.30 to 10.0 p.m., Tests, Gramophone Records.

LEIPZIG (Mitteldeutsche Rundfunk A.G.), 452 metres.

MUNCHEN (Die Deutsche Stunde in Bayern), 485 metres.

AUSTRIA.

VIENNA (Radio-Hekaphon), 770 metres. Monday and Friday, 8.0 to 8.30 p.m.

CZECHO SLOVAKIA.

PRAGUE, PRG, 1,800 metres. 8.0 a.m., 12.0 a.m., and 4.0 p.m., Meteorological Bulletin and News; 4,500 metres, 10.0 a.m., 3.0 p.m., and 10.0 p.m., Concert.

KBELY (near Prague), 1,150 metres. Weekdays, 7.15 p.m. and 10.0 p.m., Sundays, 11.0 a.m. to 12.0 noon, Concert and News.

BRUNN, 1,800 metres. 10.0 to 11.0 a.m., Concert; 2.30 p.m., News.

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SPAIN.

MADRID, PTT, 400 to 700 metres. 6.0 to 8.0 p.m., Tests.

MADRID (Radio Iberica), 392 metres. Daily (except Thursdays and Sundays), 7.0 to 9.0 p.m. Thursdays and Sundays, 10.0 to 12.0 p.m., Concerts.

MADRID, 1,800 metres. Irregular.

CARTAGENA, EBX, 1,200 metres, 12.0 to 12.30 p.m., 5.0 to 5.30 p.m., Lectures and Concerts.

PORTUGAL.

LISBON (Aero Lisboa), 370 to 400 metres. Wednesdays and Fridays, 9.30 to 12.0 p.m., Irregular Tests.

SWITZERLAND.

GENEVA, HB 1, 1,100 metres. Weekdays, 3.15 and 8.0 p.m., Concert or Lecture.

LAUSANNE, HB 2, 850 metres. Daily, 9.15 p.m., Concert and Address.

ZURICH, HBZ, 650 to 800 metres. 1.0 p.m., News and Weather Forecast; 8.15 p.m. to 10.15 p.m., Concert.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 12.0 a.m. 1,800 metres, 4.0 p.m. and 8.30 p.m., Tests, Gramophone Records.

Calls Heard

Wimbledon, London, S.W.19 (all American on 70 metres, September 22nd).
1 AAC, 1 AMW, 1 BGT, 1 BGQ, 1 BKR, 1 PA, 1 BQK, 1 XAM, 1 AVJ, 1 PTC, 1 AR (Canada), **1 ARE, 1 CKP, 1 ZT, 1 AID, 1 SF, 1 DD, 1 ZZ, 1 MY, 1 AJP, 1 ALL, 1 MW, 1 AZL, 1 RY, 1 YB, 1 ABF, 2 DX, 2 GK, 2 BRB, 2 TGB, 2 AGB, 3 CMG, BBTA, 3 CHG, 3 ADY, 3 MB, 3 BQ, 3 BG, 3 BVA, 3 VW, 4 SA, 4 XE, 4 EQ, 4 TJ, 4 IO, 8 CYI, 8 DME, 8 GZ, 8 NB, 8 BXH, 8 PL, 8 CCQ, 8 DNF, 8 ADD.** September 28th: **1 SF, 1 ZE, 1 ER, 1 FD, 1 OW, 1 DD, 1 MW, 1 BIA, 1 PA, 1 BGQ, 1 AWW, 1 CKP, 1 XAX, 1 AUR, 1 XAV, 1 AJP, 1 BKR, 2 GK, 3 GE, 3 CBL, 2 CRU, 2 WC, 2 PD, 2 BRB, 2 CQZ, 2 BY, 2 AGB, 2 CMK, 2 APY, 2 ABD, 2 KU, 4 KU, 3 COL, 3 GE, 3 CBL, 3 BTU, 3 LV, 3 BG, 3 AJD, 4 WB, 3 BSB, 3 QVA, 3 BWJ, 3 QV, 4 SA, 4 KUA, 4 KUD, 4 KU, 5 ZAS, 5 CN, 8 XS, 8 VQ, 8 CYI, 8 CEI, 8 ADD, 9 DQ, 9 BP.** (o—v—1.)
(A. L. Austen.)

Newcastle-on-Tyne.
British: **2 AM, 2 BG, 2 CC, 2 CF, 2 DR, 2 DQ, 2 DX, 2 GG, 2 JP, 2 JU, 2 KF, 2 MC, 2 NM, 2 NN, 2 PY, 2 QZ, 2 SH, 2 XX, 2 XF, 2 YT, 2 ZZ, 5 AV, 5 BH, 5 GA, 5 MA, 5 MO, 5 NT, 5 NW, 5 OC, 5 OX, 5 QG, 5 RG, 5 RZ, 5 SI, 5 SZ, 5 SN, 5 TJ, 5 WI, 5 XN, 6 FG, 6 FQ, 6 GH, 6 UG, 6 US, 6 RY.** French: **8 BQ, 8 BS, 8 CN, 8 DO, 8 RG, 8 SM, 8 VG, 8 ZF.** Dutch: **0 AAB, 0 BA, 0 GC, 0 NN, 0 QR, 0 QW, 0 RE.** Belgian: **4 BA, 4 IX, 4 US, W 2, W 2 I, 4 C 2.** German: **1 CF, 1 SF, 1 VA.** American: **4 TET, 5 ATI 1 FGI.** Unknown: **G 84, G 8 V, NY, EAB.** (o—v—1.)
(F. Thompson, **2 AWK.**)

Northampton (August 21st—September 21st).
Telephony: British: **2 AHH, 2 AIT, 2 BZ, 2 DU, 2 FV, 2 GG, 2 IL, 2 JR, 2 KO, 2 KP, 2 KV, 2 NM, 2 NP, 2 NV, 2 MP, 2 QR, 2 TU, 2 VG, 2 YV, 2 YX, 5 AK, 5 CP, 5 DY, 5 IY, 5 FI, 5 QV, 5 YS, 5 YI, 5 YW, 6 BBC, 6 IM, 6 MJ, 6 NI, 6 XQ.** American: **2 XI.** Morse, British: **2 AM, 2 ASH, 2 CA, 2 CC, 2 DQ, 2 DX, 2 GW, 2 HF, 2 IM, 2 JF, 2 JP, 2 MC, 2 NO, 2 OA, 2 OD, 2 PP, 2 PQ, 2 QQ, 2 SH, 2 TO, 2 VW, 2 WA, 2 XG, 2 YT, 5 BH, 5 BV, 5 CQ, 5 FS, 5 GA, 5 KM, 5 LF, 5 LS, 5 MA, 5 MO, 5 DN, 5 FW, 5 NW, 5 OC, 5 RQ, 5 RZ, 5 SI, 5 SU, 5 SZ, 5UL, 6 GW, 6 GM, 6 LJ, 6 MP, 6 NF, 6 RK, 6 RY, 6 TD, 6 TM, 6 UC, 6XX.** French: **3 AD, 3 CA, 3 XO, 8 AG, 8 AQ, 8 BA, 8 BG, 8 BN, 8 BP, 8 BS, 8 BV, 8 CA, 8 CF, 8 CN, 8 CO, 8 CT, 8 CZ, 8 DA, 8 DI, 8 DO, 8 DP, 8 DS, 8 ÉK, 8 ÉM, 8 ÉU, 8 FC, 8 FK 2, 8 FSF, 8 IP, 8 JHL, 8 JL, 8 MN, 8 MU, 8 NO, 8 NS, 8 OK, 8 PA, 8 PP, 8 PQ, 8 RCR, 8 RG, 8 RO, 8 RR, 8 MP, 8 SM, 8 SR, 8 SSU, 8 UU, 8 VG, 8 WJ, 8 WK, 8 WL, 8 WZ, 8 ZM, 8 ZZ, GB.** Dutch: **0 BA, 0 BQ, 0 BU, 0 GA, 0 GC, 0 MR, 0 MS, 0 NN, 0 QW, 0 RE, 0 TP, 0 XF, 0 XP, 0 XQ.** Luxemburg: **0 PG.** Belgian: **4 C 2, 4 LA, 4 RS, 4 RT, 4 WR, 4 YZ, W 2.** Danish: **7 EC.** Italian: **1 MT, 1 FP, 1 GN, MM, ICS, IDO.** Swedish: **SMZS, SMZV, SMZY.** Norwegian: **ÉCA.** German: **AGW.** Algiers: **HBS.** Unknown: **IO 2, CA, YA 1, YA 20, YA 21.**
(P. H. Brigstock Trasler.)

Northampton (August 31st to September 21st).
British: **2 AFL, 2 ASH, 2 CC, 2 DU, 2 DX, 2 FN, 2 GG, 2 GW, 2 IH, 2 JR, 2 JU, 2 KO, 2 KV, 2 NM, 2 NV, 2 OA, 2 OD, 2 PP, 2 QR, 2 RI, 2 SH, 2 TD, 2 TF, 2 VG, 2 VJ, 2 VW, 2 WD, 2 XD, 2 XG, 2 XY, 2 YV, 2 YX, 2 ZU, 5 AK, 5 BH, 5 BV, 5 DN, 5 FI, 5 ID, 5 IK, 5 IY, 5 KM, 5 LF, 5 LS, 5 MA, 5 MO, 5 OT, 5 RZ, 5 SI, 5 SU, 5 UL, 5 UQ, 5 YW, 6 BBC, 6 GM, 6 HY, 6 MJ, 6 MP, 6 NF, 6 PE, 6 TD, 6 TM, 6 Q.** French: **8 BC, 8 BG, 8 BN, 8 BP, 8 CA, 8 CF, 8 CH, 8 CN, 8 CO, 8 CT, 8 CZ, 8 DD, 8 DI, 8 DO, 8 DP, 8 ÉK, 8 ÉJ, 8 ÉP, 8 ÉU, 8 FC, 8 FH, 8 FK, 8 FV, 8 FW, 8 GG, 8 GV, 8 IP, 8 JHL, 8 KBR, 8 ML, 8 MN, 8 MP, 8 NS, 8 OK, 8 OS, 8 PD, 8 PF, 8 PP, 8 PQ, 8 RG, 8 RM, 8 RO, 8 RR, 8 SR, 8 SSU, 8 UU, 8 VG, 8 WL, 8 WZ, 8 XH, 8 XR, 8 ZM, 8 ZZ, 3 AD, 3 CA, 3 XO.** Dutch: **0 BA, 0 BQ, 0 GA, 0 JR, 0 KV, 0 MS, 0 NN, 0 PA, 0 QW, 0 XP, 0 FQ, 0 ZO.** Swedish: **SMZN, SMZP, SMZV, SMZY, SMZZ.** Italian: **1 EP, 1 GN, 1 MT, 1 CS, IDO, MM.** Belgian: **4 AU, 4 RS, 4 YZ, W 2.** Luxembourg: **0 AA.** Finnish: **2 NM.** Swiss: **9 AD.** Danish: **7 EC.** Algiers: **HBS.** American: **2 GK** Unknown: **YA 24, IO 2, GB, 9 XX.** (1—v—o.)
(W. F. B. Shaw.)

Watford (during September). All below 200 metres.
British: **2 BR, 2 CC, 2 DR, 2 GW, 2 KZ, 2 MC, 2 NM, 2 OD, 2 PY, 2 TD, 2 VE, 2 VJ, 2 WC, 5 BV, 5 DN, 5 ID, 5 KM, 5 LF, 5 MA, 5 MO, 5 OX, 5 PE, 5 QG, 5 SI, 5 UL, 6 AL, 6 AN, 6 BY, 6 DW, 6 GH, 6 GM, 6 KJ, 6 NF, 6 ON, 6 OU, 6 TM, 6 UD.** French: **8 ACR, 8 AU, 8 BC, 8 CA, 8 CZ, 8 DA, 8 DI, 8 DP, 8 ÉU, 8 GI, 8 JHL, 8 PQ, 8 PP, 8 RM, 8 RR, 8 SR, 8 SSU, 8 UU, 8 VG.** Dutch: **0 ZO, 0 BA.** Danish: **7 EC, 7 QF.** Swedish: **4 SMZY.** Finnish: **FN 2 NM.** Italian: **1 FP.** American: **1 SF, 3 BVA, 3 MB, 4 SA, 8 KI, 8 NB, 8 PL.** Canadian: **1 AR.** Miscellaneous: **1 GN, 3 CA, 3 XO, 4 YZ, 10 KZ, UX 8.**
(H. E. Nicholson, **6 VP.**)

Islington, London, N.1 (during September).
British: **2 ABJ, 2 ARB, 2 AU, 2 CA, 2 DX, 2 IS, 2 KT, 2 KX, 2 KZ, 2 NM, 2 OD, 2 ON, 2 QQ, 2 TF, 2 UV, 2 VW, 2 YT, 2 ZA, 5 AL, 5 DN, 5 JX, 5 KM, 5 LP, 5 MA, 5 NW, 5 OX, 5 PU, 5 PZ, 5 RZ, 5 SI, 5 TR, 5 UL, 6 AL, 6 DW, 6 GM, 6 HP, 6 HY, 6 MP, 6 NF, 6 NG, 6 QZ, 6 SB, 6 TM, 6 UD.** French: **8 FC, 8 KK, 8 RG, 8 SM, 8 VG, 8 WL.** Dutch: **0 BA, 0 GA.** Danish: **7 EC, 7 ZM.** Swedish: **SMZV.** Unknown: **4 YZ, QRA, PSE, 9 AN.**
(C. E. Bradley.)

West Norwood, S.E.27 (during September).
2 CV, 2 EX, 2 IH, 2 NK, 2 QI, 2 ZK, 2 XAU, 5 CF, 5 KM, 6 JO, 6 PE, 6 US, 8 BC, 8 CA, 8 CO, 8 FC, 8 FK, 8 FVQ, 8 GI, 8 JHL, 8 GI, 8 OK, 8 PP, 8 PQ, 8 RR, 8 UU, 0 GA, 0 KM, 0 LO, 0 TP, 0 QW. Various: **GB, 4 YZ, IO 2, F 3, SMZV, WGH.** American: **1 XAV, 2 BRB, 3 ADP, 3 AJD, 3 BTU, 4 SA, 5 ZA, 8 BDO, NFV:** (o—v—o and o—v—1.)
(L. F. Aldous, **2 ACX.**)

East Aberthaw, near Cardiff (September 1st to 30th). All C.W. or I.C.W., except telephony.
British: **2 BN, 2 CC, 2 DX, 2 IH, 2 JF, 2 KO, 2 NM, 2 OA, 2 DD, 2 TF, 2 TO, 2 WG, 2 XD, 2 YT, 5 BH, 5 BS, 5 BV, 5 CQ, 5 FS, 5 GI, 5 HT, 5 LS, 5 MO, 5 RQ, 5 SU, 6 BN, 6 GB, 6 NF, 6 SH, 6 TD, 6 TH*, 6 UD.** French: **8 AR, 8 AL, 8 AW, 8 BU, 8 BN, 8 BP, 8 CA, 8 CO, 8 CF, 8 DI, 8 DO, 8 DP, 8 ÉK*, 8 ÉM, 8 FN, 8 GB, 8 GI, 8 HS, 8 HL, 8 JHL, 8 LO, 8 LW, 8 MUF, 8 NU, 8 NS, 8 OK, 8 PG, 8 RI, 8 RQ, 8 RM, 8 RR, 8 SI, 8 SU, 8 SSU, 8 UU, 8 WK, 8 WL, 8 WZ, 8 WO, 8 XH, 8 XR, 8 YR, 8 ZM, FL.** Dutch: **0 II. 0 KD, 0 CDJ, 0 LO, 0 TP, 0 XP, P 1.** Belgian: **W 2, 4 WR.** Swedish: **SMZY.** Italian: **1 DO, 1 HT.** Danish: **7 EC** Various: **3 CA, 4 SS, HBS, LOAA, 1 FL, 1 ER, WGH.** *Telephony. (All between 90-150 metres.) (o—v—o.)
(C. Prosser, **2 ACK.**)

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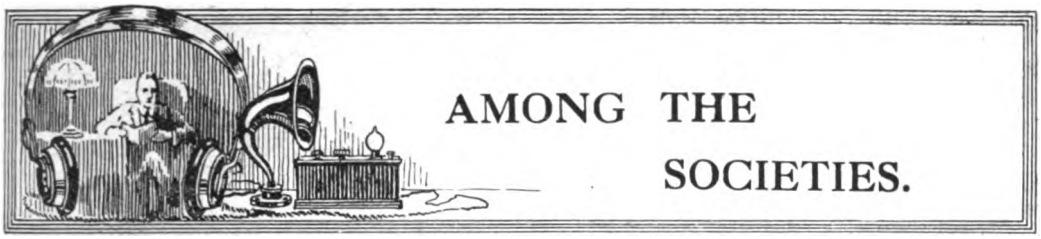

AMONG THE SOCIETIES.

RADIO SOCIETY OF GREAT BRITAIN.

An Ordinary Meeting of the Society will be held at the Institution of Electrical Engineers, Savoy Place, W.C. 2, at 6 p.m. this evening (Wednesday), when Mr. R. H. Barfield, M.Sc., will deliver a lecture entitled "Unsolved Problems of Wireless."

A meeting of the Transmitter and Relay Section will be held in the same building at 6.30 p.m. on Friday, October 24th, when Mr. P. R. Coursey, B.Sc., will give a talk on High Tension Condensers.

Modern amateur transmitting apparatus formed the subject of Col. F. E. Wenger's Presidential address before the Stoke-on-Trent Wireless Society on October 9th. Before proceeding to a consideration of present-day practice, Col. Wenger had some interesting things to say on the hardships of the early amateur transmitter, who was up against the troubles of spark transmission. Rapid progress had been made in recent years since the introduction of the thermionic valve.

After the many circuits in use had been clearly explained, transmission experiments were carried out in the Lecture Room and received on one of the Society's sets.

* * * *

Over a hundred persons were present at the Hackney and District Radio Society's Public Meeting and Exhibition held on October 6th.

A large number of sets were on show and transmissions from 2 LO were reproduced on two five-valve receivers constructed by Messrs. G. E. Sandy and J. R. Jones.

Among the speakers during the evening was the Mayor of Hackney.

It is hoped that this demonstration will bring in new members.

* * * *

A Presidential Address on "Electrons" was given before the Smethwick Wireless Society by Dr. Murray, M.Sc., on October 3rd. Over 100 members and visitors were present.

Dr. Murray, who illustrated his extremely lucid remarks with numerous lantern slides, dealt with both the chemical and physical sides of his subject and enumerated the theories of Sir Oliver Lodge, Dr. Wall and others.

* * * *

A party of members of the Wimbledon Radio Society visited the All-British Wireless Exhibition on October 4th, proceeding afterwards to the London Coliseum, where Harry Tate's sketch, "Broadcasting," was included in the programme.

On the Sunday following experiments were conducted with portable apparatus on Great Bookham Common, Surrey.

At the Glasgow and District Radio Society's inaugural meeting for the winter session, held on October 8th, Mr. Eric Snodgrass, a former President, lectured on "A Neutrodine Receiver." In addition to the set under discussion, which comprised four valves, some interesting high and low frequency units were shown in which many novel features had been introduced.

FORTHCOMING EVENTS.

WEDNESDAY, OCTOBER 22nd.

Radio Society of Great Britain. Ordinary Meeting. At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Unsolved Problems of Wireless." By Mr. R. H. Barfield, M.Sc.

Streatham Radio Society. At 35 Streatham High Road. Surprise Night.

Radio Research Society, Peckham. At 44 Talfourd Road. Lecture with apparatus: "The Wimhurst Machine and Static Electricity."

Halifax Wireless Club. At the White Swan Hotel. Lecture: "The Design of Broadcast Receivers." By Mr. F. H. Haynes.

Clapham Park Wireless and Scientific Society. At 7.45 p.m. At 67 Balham High Road. Lecture: "The Scientific Work of James Clerk-Maxwell." By Prof. W. Wilson.

Edinburgh and District Radio Society. Lecture: "The Flewelling Receiver." By Mr. S. Cursitor.

Tottenham Wireless Society. Discussion: "How it Works—The Valve."

THURSDAY, OCTOBER 23rd.

Institution of Electrical Engineers. At 6 p.m. (light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Inaugural Address by Mr. W. B. Woodhouse, President. Presentation of Premiums.

Bournemouth and District Radio and Electrical Society. At 7 p.m. At Canford Hall, St. Peter's Road. Lecture by Capt. E. J. Hobbs, M.C.

Derby Wireless Club. Demonstration of H.T.-less Circuits, by Mr. Groy.

Walthamstow Amateur Radio Society. Lecture: "Elementary Radio Theory." By Mr. R. H. Cook.

Luton Wireless Society. At 8 p.m. At Hitchin Road Boys' School. Experiments with New Circuits and Demonstrations for Beginners.

Hounslow and District Wireless Society. Surprise Night.

FRIDAY, OCTOBER 24th.

Bristol and District Radio Society. Social Evening at Comer's Restaurant. 7 p.m. onwards.

MONDAY, OCTOBER 27th.

Hackney and District Radio Society. At 8 p.m. At King's Hall. Demonstration of Reflex Set. By Mr. Neilson.

TUESDAY, OCTOBER 28th.

Leicestershire Radio and Scientific Society. At the Y.M.C.A. Discussion on Radio Problems.

HOW TO OBTAIN THE PLETTS MAP.

Full-size copies of the ingeniously designed map of the world on page 92 of this issue, giving the true distance and direction from London of any point of the globe, can be obtained post free for 1s. 1d. from the Wireless Press, Ltd., 12-13 Henrietta Street, London, W.C.2.

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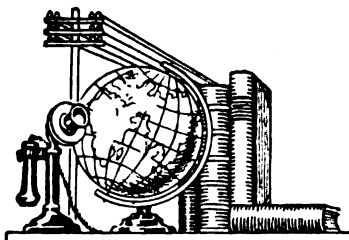

CORRESPONDENCE.

Capacity Effects on Mutual Inductance.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Referring to the enquiry on coupling in three-coil tuners on page 726 of *The Wireless World and Radio Review* of September 17th, the enquirer has stumbled across what I found out some two years ago and which appeared in a paper before the Wireless Society of London (*The Wireless World and Radio Review*, June 17th, 24th, and July 22nd, 1922) entitled "The Effects of Capacity on Mutual Inductance." I then showed that in the case of two right-handed helical coils joined as shown the electrostatic and the electromagnetic couplings are in phase; if one pair, say Ae and E,

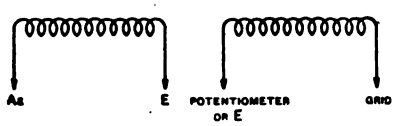

Fig. 1.

are interchanged the reverse is the case and under a certain degree of coupling may balance one another. I developed this theory into what I called the "silent point" method of elimination and I wonder that none on our southern coasts have tried this to receive 2LO through the 600 metres disturbance. I think your correspondent will find that the longer the wavelength the closer must be the coupling.

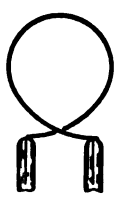

Fig. 2.

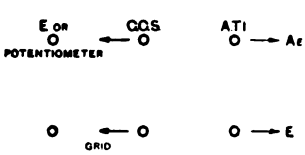

Fig. 3.

Now to make single-layer cylindrical right-handed coils correspond with honeycomb and the like as regards sign in coupling, I have found the connections to the holder should be as in Fig. 2.

Hence to avoid the silent point the connections in a three-coil mount should be, looking from the front, as given in Fig. 3.

J. H. REEVES.

London, S.W.5.

Ido and the A.R.R.L.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I am sorry to note from page 626 of your issue for August 27th, that we have embarrassed your correspondent, Mr. E. H. Turle, by our apparent inconsistency with respect to an international auxiliary language. It is quite true that when we originally undertook the solicitation of sentiments of the various national amateur radio societies of the world on this question we recommended the consideration of Ido, and I trust I am myself not unaware of the good points of that language. There is a difference, however, between recommending consideration of a thing and endorsing it.

Perhaps it is fairer to say that we did had actual Idist leanings at one time, but as our study of this problem continued we became convinced that our decision should be in favour of Esperanto. With certain minor reservations the A.R.R.L. has endorsed Esperanto, and is recommending that language to its membership.

K. B. WARNER,
Hartford, Connecticut. *Secretary-Editor.*

Swedish Transmitters.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I notice with pleasure that you publish particulars of the Swedish stations at present in operation and have pleasure in adding the wavelength of **SMZP**, which is about 120 metres.

Signals from the short wave Swedish stations come in here very strongly and can be easily read on a single valve without aerial or earth connected, *i.e.*, with send-receive switch open. This arrangement reduces signals to about half strength and atmospherics to about 10 per cent. of their strength on the aerial.

Reports have been received from **SMZP** and Finnish **2 NM** of signals from my station with an aerial current of 0·22 amps on 117 metres (aerial height, 40 ft.), in each case at great strength. This radiation gives me an effective night range of about 1,000 miles, which seems to be quite satisfactory for an input of just under 10 watts.

I would be very glad to have reports from anyone using a separate heterodyne or loose coupled set stating their opinion of my note, which I am given to believe is fairly steady. My transmission times are Wednesday and Saturday, 2200-2400, G.M.T.

W. WINKLER, **2 TF.**

Edinburgh.

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READERS PROBLEMS

Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

Errors in Wavemeters.

A CORRESPONDENT writes to say that he has purchased a wavemeter, together with a calibration chart, and finds that a distinct error is observable on a certain given wavelength. He asks if it will be sufficient to find the magnitude of this error for the wavelength in question, and to make a similar correction throughout the range of the instrument.

It will be possible to apply an additive correction in this manner only if the error is due to the fact that the wavemeter dial has slipped slightly on its spindle. If the error is due to any alteration of the spacing of the condenser vanes, or the turns in the inductance coil, the correction could not be made in this way, and the instrument would have to be completely recalibrated. One of the simplest ways of checking a wavemeter is to tune in a transmitting station, the wavelength of which is known to be reasonably accurate, and then to excite the receiver by means of the wavemeter, noting the position on the wavemeter which gives maximum signal strength.

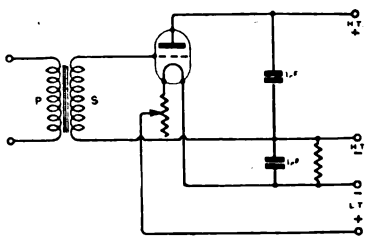
The wavemeter scale readings and wavelengths of a series of stations should be taken and a curve plotted through the points obtained. The advantage of this method is that one obtains the average of the standard wavemeters used at different stations, and the chances of error are thereby considerably reduced.

Obtaining a Grid Bias Without Batteries.

DRY batteries in a wireless receiver often become a source of trouble, either by running down or giving rise to crackling noises. Any method by which dry batteries can be eliminated should be adopted whenever possible. If the same type of valves are always used in the low frequency stages of a receiver, and if the anode current is kept constant, grid batteries may be eliminated by using a resistance to obtain the negative grid bias for the magnifying valves.

A circuit showing the position of the resistance in the receiver is given below. It will be seen that it is connected in series with the H.T. battery, so that the whole of the steady anode current to the valves in the receiver passes through it. A difference of potential is therefore established between the ends of the resistance, and by connecting the filament ends of the secondary windings of the transformers to the negative ends of the resistance, this potential may be applied to the grids of the valves. It will be seen that any change in the anode current which may be brought about by changing the H.T. voltage or making use of other types of valves will affect the value of the grid bias. The method is therefore only suitable when the anode current can be kept constant.

To calculate the value of resistance required, first measure the total anode current by placing a milliammeter between the minus side of the H.T. battery and — L.T.: then, knowing the value of grid bias required, the resistance may be calculated from Ohm's law. As an example, let us assume that the total anode current is 7·5 milliamps, and that a grid bias of 5 volts is required. The resistance which will have to be connected in the H.T. circuit is therefore 5 divided by ·0075 or 675 ohms.



A method of obtaining a negative grid bias.

The fact that the resistance is connected both in the anode and grid circuits of the valves may cause self-oscillation, and it is therefore advisable to shunt the resistance with a condenser of large capacity.

Tuning Two Stages of H.F. Amplification.

WHEN using a double tuning condenser to tune simultaneously the anode circuits of two H.F. valves, it is always advisable to use a vernier condenser in parallel with one half of the condenser, in order to balance out any differences in the capacities associated with the wiring of the anode coils.

A correspondent has tried to dispense with the vernier condenser by matching his anode coils by the following method.

One of the two H.F. valves is switched off, and a coil inserted in the anode circuit. A station of constant wavelength is then tuned in, and the position of the anode tuning condenser noted. A second coil is then substituted in the anode circuit, and the set retuned. Turns are then added or taken off the anode coil until the condenser reading is the same as in the first experiment.

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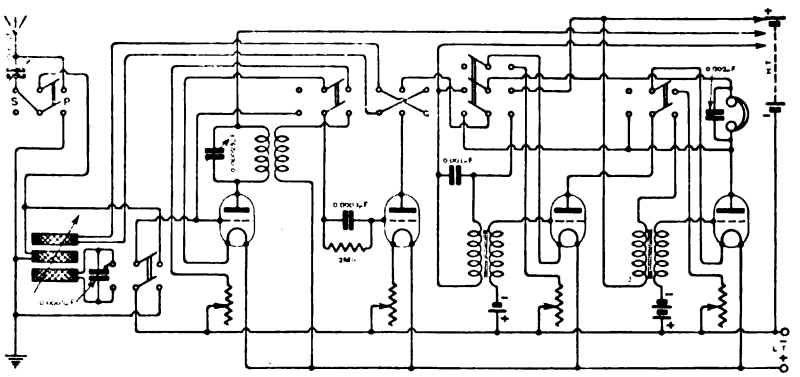
With this method it does not necessarily follow that the vernier condenser can be dispensed with. The test gives coils of the same natural wavelength, but not necessarily of the same inductance value. If the two coils, after being balanced in this manner, have different self-capacities, the rate of change of capacity required to give a uniform rate of change of wavelength will be different in each case, and a vernier condenser will still be necessary if best results are to be obtained.

A FOUR-VALVE RECEIVER WITH SEPARATE H.T. SUPPLIES FOR H.F., DETECTOR AND L.F. VALVES.

IN the diagram given below, three separate H.T. tappings are provided for the H.F., detector, and L.F. valves, and the switching of the valves has been so arranged that each valve receives the correct anode voltage, with every possible combination of the valves.



A four-valve receiver with separate H.T. supplies for the H.F., detector and L.F. valves.

In addition to the two-pole change-over switches for the H.F. valve and the last L.F. valve, a three-pole change-over switch will be required for the first L.F. valve, in order to connect the telephones to the detector H.T. tapping, when both L.F. valves are switched out of circuit. A coupled tuning circuit is employed, and the H.F. valve is transformer coupled to the detector.

It will be noticed that separate by-pass condensers are connected across the primary winding of the first intervalve transformer and the telephones. By this means the telephone condenser will always be in circuit, and may be adjusted to suit the characteristics of the telephones or loud-speaker. If the telephones or loud-speaker are not sensitive to changes of the shunting condenser, a single condenser may be connected between one side of the reaction coil and the detector + H.T. tapping, and will then be automatically connected across either the transformer primary winding or the telephones, whichever happen to be in series with the reaction coil.

THE CURVATURE OF SQUARE LAW CONDENSER PLATES.

WE have been asked recently to give an account of the methods used to calculate the curvature of condensers in which the capacity varies as the square of the angle of rotation. The method is somewhat involved, and it would not be possible to describe it in full in the small space at our disposal. Readers who are interested in this subject are referred to Chaper II of *The Calculation of Inductance and Capacity*, by W. H. Nottage, and to Chapter X of *The Principles of Radio Communication*, by Professor J. H. Morecroft. The method of calculation was due originally to Duddell.

SEPARATE H.T. VOLTAGES FOR L.F. VALVES.

WHEN switches are used to control the number of valves in use in an L.F. amplifier, there is often a difficulty in ensuring that the H.T. voltage received by a given valve is not affected when the circuit is changed. One method which has been suggested consists in using a single main H.T. battery for all the valves, and in supplementing this voltage with auxiliary batteries connected between the plates of the valves and the change-over switches. We have been asked whether this method possesses any serious disadvantages.

The only objection that can be raised to the use of extra H.T. batteries is that these batteries must be very carefully insulated and placed in such a way that their capacity to earth is as small as possible. Any capacity to earth possessed by these batteries will be shunted between the plate of the valve and earth, and may act in such a way as to reduce the amplitude of the voltage fluctuations at the plate of the valve. It is better to employ three-pole switches to obtain variable tappings from the main H.T. battery. A circuit showing the use of switches of this type was given on page 639 of the issue of August 26th, 1924.

Another very satisfactory method of switching consists in the use of telephone plugs and jacks.

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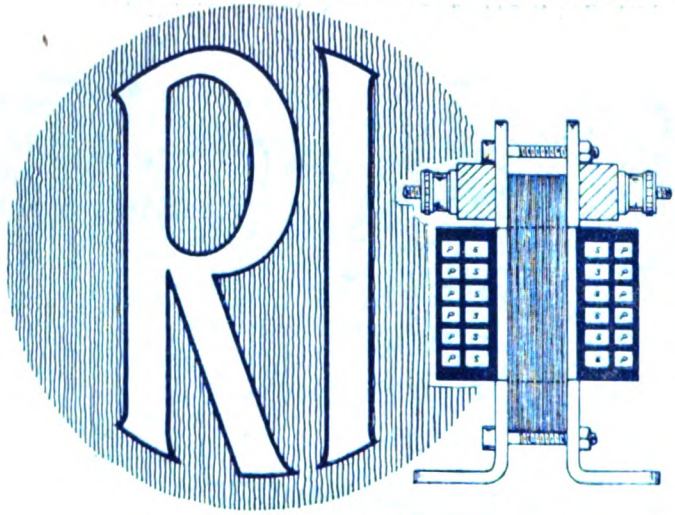

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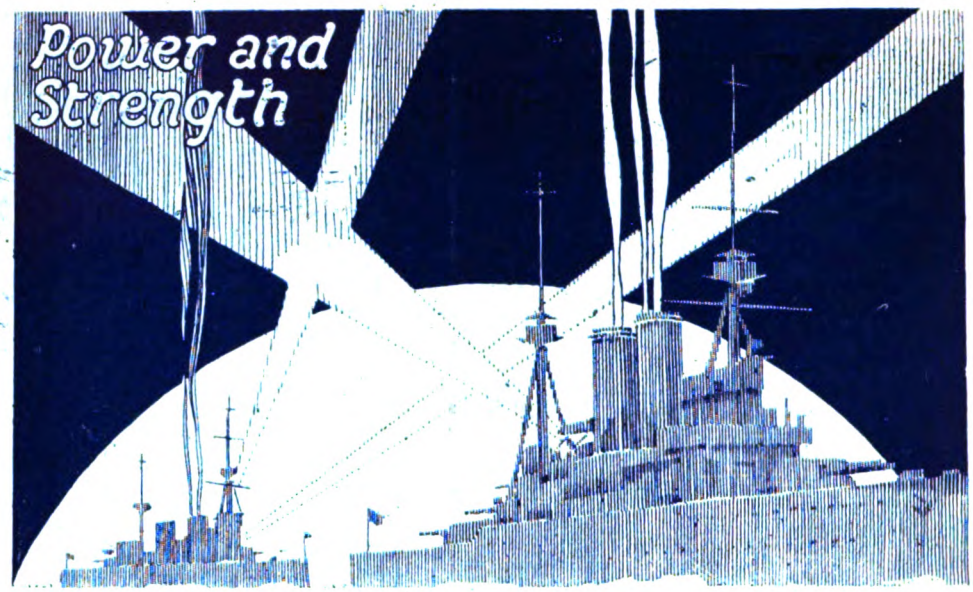

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS

AMATEURS GIRDLE THE WORLD

[AMERICAN PAPERS PLEASE COPY]

AMATEUR achievement has made such enormous strides during the last twelve months that almost anything in the way of long distance communication seemed possible of fulfilment. We say "almost" anything because we doubt whether the dreams of the most optimistic British amateurs could ever have imagined that direct communication on such low power as they are entitled to use could have succeeded in establishing intercourse between this country and New Zealand, which is practically the farthest point from England on the globe which could be reached. For months past American amateurs have endeavoured to establish two-way communication with New Zealand, but so far without success, and therefore it is all the more to the credit of British amateurs that they should have achieved these successes in spite of the greater distance which they have had to cover.

The first intimation which we received of the possibility of Australasian signals from amateur stations reaching this country was a report from Mr. R. W. Galpin, **5 NF**, on October 6th, that on the morning of the previous Sunday, at 5.45, he heard a station calling CQ DE A2ADJ. Mr. Galpin points out that it was not for some while that he realised what he had done on account of failing to recognise the significance of the initial letter "A," which is, of course, the prefix for Australian amateur transmissions. Up till now, however, we have had no confirmation of this reception, and we believe there are no three-letter calls yet issued to Australian amateurs.

The next achievement reported to us was on Saturday morning, October 18th, when Mr. C. W. Goyder, working with the Mill Hill transmitting set, **G 2 SZ**, actually established two-way communication with New Zealand, carrying on an exchange of signals with **Z 4 AA** for over half-an-hour from 6.15 a.m. He received a congratulatory message to the Radio Society of Great Britain and was asked to inform Mr. E. J. Simmonds, **G 2 OD**, that he also had been heard strongly in New Zealand on the previous night, so that this appears to establish that the first British amateur signals to be received in New Zealand emanated from the station of Mr. Simmonds, whilst the distinction of achieving the first two-way working falls to Mr. Goyder. Mr Galpin's reception, if confirmed, would be the first reception of an Australian amateur by a British amateur.

On the morning of Thursday, October 16th, Mr. Simmonds heard the New Zealand station, **Z 4 AG**, working, and this reception was confirmed by an exchange of cables between *The Wireless World* and Mr. Slade, the owner of the New Zealand Station. Since these first achievements two-way working has also been carried out by Mr. J. A. Partridge on the morning of October 19th, and by Mr. Gerald Marcuse, Secretary of the Transmitter and Relay Section of the Radio Society. Mr. Goyder, Mr. Partridge, and Mr. Simmonds have, in addition, repeated their earlier successes, Mr. Partridge conveying congratulatory messages between the Premier of New Zealand and the High Commissioner in London.

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Reports of reception of New Zealand amateur stations have also been received from several additional sources. Mr. W. A. S. Batement, of London, N.W., **G 6 TM**, heard **Z 4 AA**, **Z 4 AG** and **Z 4 AK** on the morning of October 20th; Mr. R. L. Royle, of Palmers Green, **G 2 WJ**, received these same stations also on the morning of the 19th inst. Mr. C. L. Ward, of South Farnborough, Hants, heard **Z 4 AK** calling a French and a British station, also on the morning of the 19th inst., whilst Mr. J. H. D. Ridley, of Blackheath, on an Ultra III receiver, listened to **Z 4 AA** on the mornings of the 19th and 20th inst., and Mr. F. R. Neill, of Whitehead, Co. Antrim, received **Z 4 AA** and **Z 4 AG** on 2 valves on the 19th, 20th and 21st, between 6 and 7.30 a.m., signals from the former being still readable at 7.45 in broad daylight. A further report from Mr. Hugh N. Ryan, of Wimbledon, states that he has so far heard the three stations **Z 4 AA**, **Z 4 AG** and **Z 4 AK** and that **Z 4 AA** could be heard quite well using a single-valve receiver.

It is interesting to mention that Mr. R. J. Orbell, New Zealand, **3 AA**, who has recently conducted experimental transmissions whilst on the s.s. "Timaru," from New Zealand to London, arrived in London two or three days ago and was able to work to his New Zealand friends from Mr. Goyder's station.

Such an extraordinary achievement must do much to add to the status which the amateur has already earned for himself, and there is no doubt that these results provide data of the utmost scientific value.

A "TELLING" NATIONAL SERVICE.

IT is refreshing to be able to express views having a direct relation to the General Election which is now taking place, but without encroachment on the non-political character of a wireless journal. Amid all the many activities of the interested parties plunging into the fray, there is *one* factor which is the servant of all parties, and, above all, the servant of the electorate.

To those who have watched the gradual extension of applications of wireless it is highly gratifying to note the great use which is being made of wireless throughout the length and breadth of the land for carrying the political message to those, under ordinary conditions, beyond the reach of the speakers. We perhaps hardly realise the real value from a national standpoint of this tremendous neutral force in these days when it is a much too common habit to take things for granted. But, however nonchalant the general public may be as to the facilities provided for their general edification during the election by the medium of wireless, it must provide a source of the greatest satisfaction to those who have contributed so much in the past and those who still continue to contribute to the development and perfection of transmission and of reception.

To what higher use can the wireless be put than national service? The B.B.C. in the present crisis are deserving of the unstinted thanks of the nation at large for their patriotic action in obtaining authority to offer equal facilities to all parties for the broadcasting of political speeches. By its action in thus grasping the opportunity to serve the nation in this manner, the B.B.C. have set an example which it would be for the general well-being of the nation for all to emulate. The political educational value of the broadcasting of representative political utterances is of the highest importance.

There is no doubt that it is advisable that a limit should be put upon the extent to which wireless should be used in politics. As a means whereby leaders of political parties may acquaint the country of their policy it is invaluable, but we still hold to views expressed in an editorial paragraph recently, when we indicated that it is not always the best orator who, with his eloquence, can influence the masses, who is necessarily the best statesman or the advocate of the wisest policy.

Most of us can recall how, during the early days of wireless in this country, there was much pessimism expressed as to the ultimate value of broadcasting, but, viewing the wonderful stream of successes which have been achieved, the further hopes yet to be consummated, we take the opportunity of congratulating on this occasion all the participants in the "wireless way of progress" which, under highly efficient organisers, is rendering definite national service in many spheres, not the least of which is Education.

THE EDITOR.

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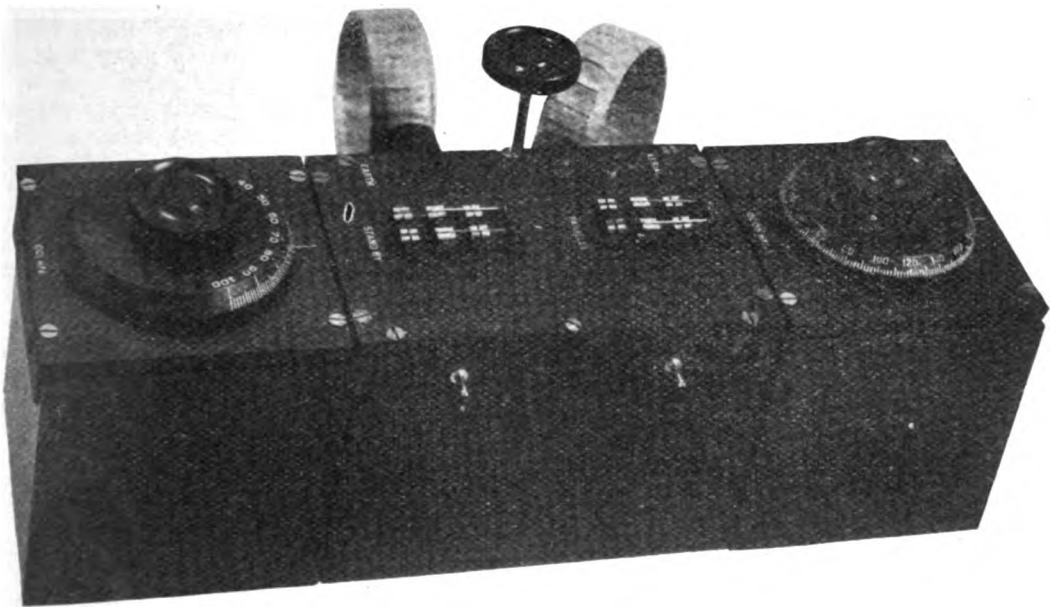

A THREE-VALVE UNIT RECEIVER.

The units of this receiver have been specially designed to permit of a number of different circuits being tried, not by altering the connections, but by plugging-in appropriate units.

By R. H. Cook.

ONE of the most popular types of receiver has always been the unit system, due, no doubt, to the fact that for a small outlay one can start with a complete set, and yet can always add to it and increase its efficiency and possibilities. Most of these sets are designed so that there is a separate type of unit for each part of the circuit. For instance, the tuner unit, the H.F. unit, the detector unit, and the L.F. unit. If only a one-valve set, consisting of the detector and tuner units, is bought or made at the outset, then, when one wishes for an extra valve, either a note magnifier or a H.F. unit is added. In this way, without incurring any heavy initial expense, one can, in time, build up quite a powerful receiver.

This is all very nice, but there is still one great limitation which stops this type of receiver from being the perfect one. To have a two-valve unit receiver one must first of all decide which type of circuit to have, and in the general run of straight circuits one can use two valves in any of the following combinations :

2 H.F. valves and crystal.
1 H.F., crystal and note magnifier.
Crystal, and two note magnifiers.
1 H.F. and valve detector.
Detector and 1 note magnifier.

There are at least five circuits from which one can choose, and if the number of H.F. and L.F. couplings is taken into consideration, then one can more than double this number.

With the usual type of unit receiver, separate and distinct units are required when it is desired to introduce a variety of couplings.

The purpose of the present article is to describe the design of a system in which an

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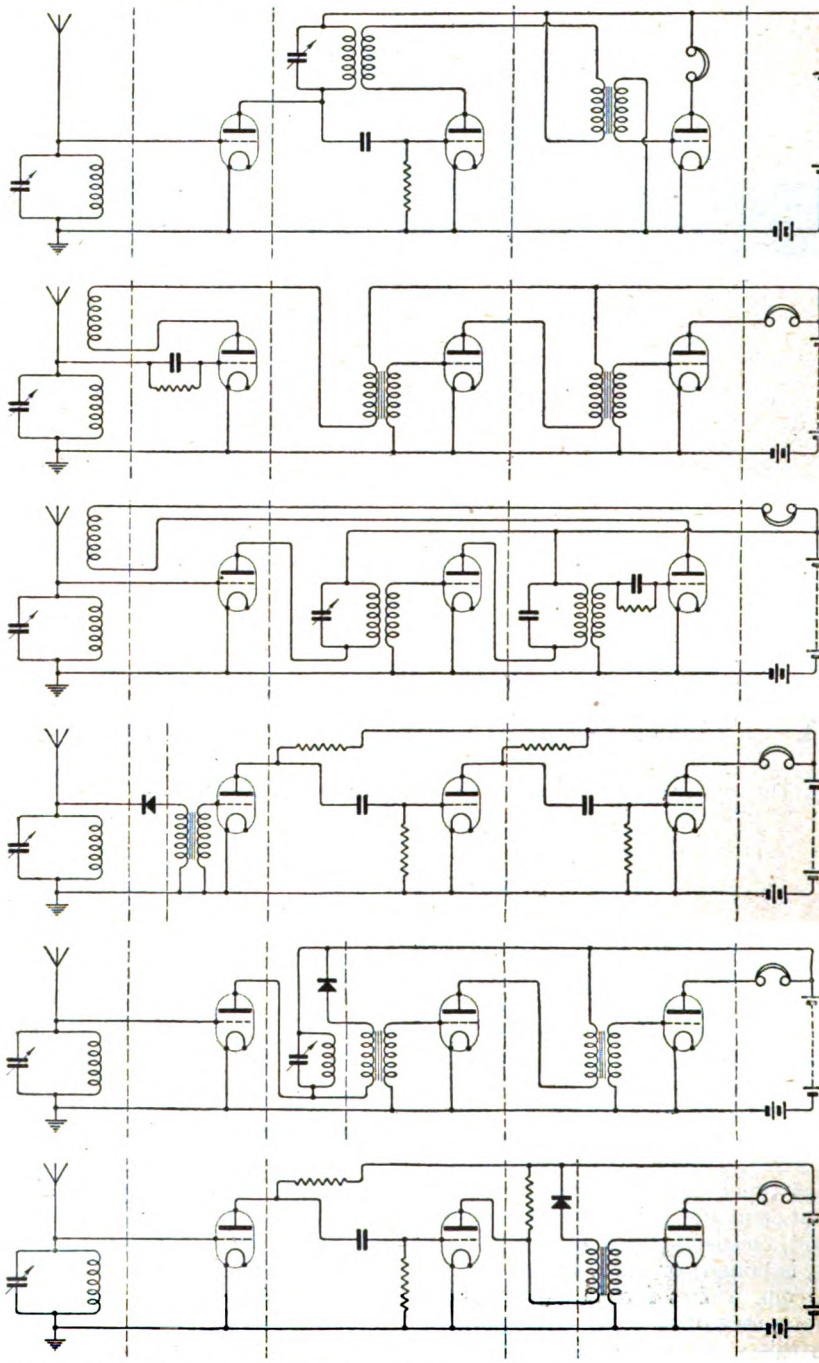

Circuits which may be tried with the unit receiver :—
Upper circuit, H.F. (tuned anode), detector, and transformer-coupled L.F.
Second circuit, detector and two stages of transformer-coupled L.F.
Third circuit, two stages of transformer-coupled H.F. and detector.
Fourth circuit, crystal detector and three stages of resistance-coupled L.F.
Fifth circuit, H.F. (tuned anode), crystal detector, and two stages of transformer-coupled L.F.
Sixth circuit, two stages of resistance-coupled H.F., crystal detector, and one stage of L.F.

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attempt has been made to do away with these great limitations.

First of all it occurred to the writer that the most popular number of valves would be three. With this number of valves one can get quite a large number of circuits, some of which are shown in Fig. 1. They are divided up into units as indicated by means of dotted lines.

These circuits can be altered further by having different methods of coupling, as will be shown when describing the amplifier and detector units.

A glance at Fig. 1 will show the reader, unless he is already familiar with the fact, that *all valve circuits are the same except for the method of coupling*, and that even the connections for these methods of coupling are very similar.

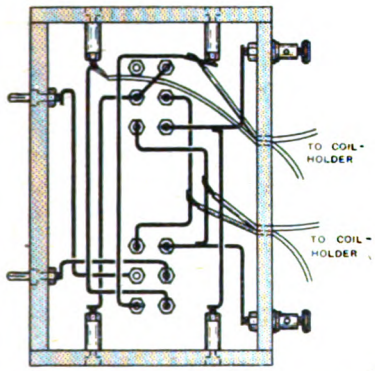

Fig. 2. Wiring of the tuning unit.

It is this fact that is made use of in the present design, and was also responsible for the H.F. amplifier published in the issue of August 13th last. Whereas in most unit systems different types of valve panels are employed, in the writer's design all valve panels are the same, whether used for detector, H.F. or L.F., and the coupling unit is plugged in.

In the article mentioned above, this method was used with high frequency couplings, but in this unit receiver the method is employed with all methods of coupling. By plugging in an L.F. transformer we have a note magnifier. By removing the transformer and plugging in an H.F. coupling the unit can be used as a second stage of high frequency amplification, or as a detector following an H.F. amplifier.

The Tuning Unit.

This unit consists of a panel carrying two double-pole switches, and is mounted on ebonite strips on all four sides (Figs. 2 and 3.) One of the double-pole switches is connected to the aerial circuit for the purpose of switching the aerial condenser in series or parallel with the aerial tuning coil. The second switch is connected to the aerial and closed circuits, and is employed to switch the aerial or the closed circuit to the output terminals of the unit.

The panel measures 4 ins. by 6 ins. by $\frac{1}{4}$ in., and the ebonite strips to which the panel is secured are $\frac{3}{4}$ in. wide. The panel and side strips are in turn mounted on a box, making the complete unit 6 ins. by 4 ins. by 4 ins.

On the left-hand side of the box is mounted the two-coil holder, as may be seen from the photograph. This can be used to accommodate the aerial and secondary coils, or the aerial and reaction coils. The two terminals fixed on the left-hand strip are for the aerial and earth connections. On the right-hand strip two valve pins are mounted. These are connected across the centre contacts of the stand-by tune switch, and fit sockets on the next unit, which are joined to the grid and filament of the valve respectively.

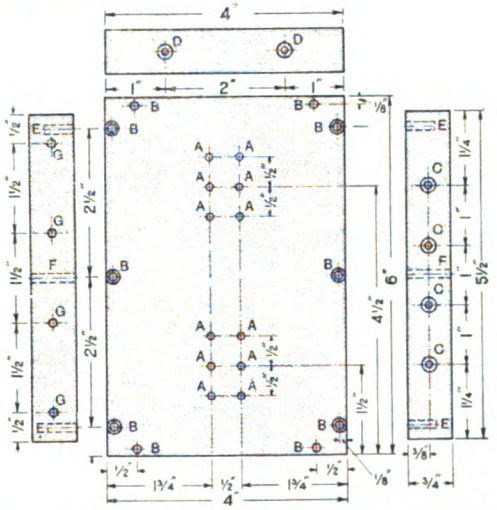

Fig. 3. Details of the panel and side strips of the tuning unit. Drilling particulars are as follows: A, $\frac{1}{8}$" for 6 B.A. clearance; B, 5/32" and countersunk for 4 B.A. screws; C, $\frac{1}{4}$" for 6 B.A. screws and counter bored $\frac{1}{4}$" dia. and $\frac{1}{8}$" deep; D, 5/32" for 4 B.A. screws and counter bored $\frac{1}{4}$" dia. and $\frac{1}{8}$" deep; E, tapped for 4 B.A. screws and $\frac{1}{2}$" deep; G, 5/32" for 4 B.A. screws; H, 7/16" dia.

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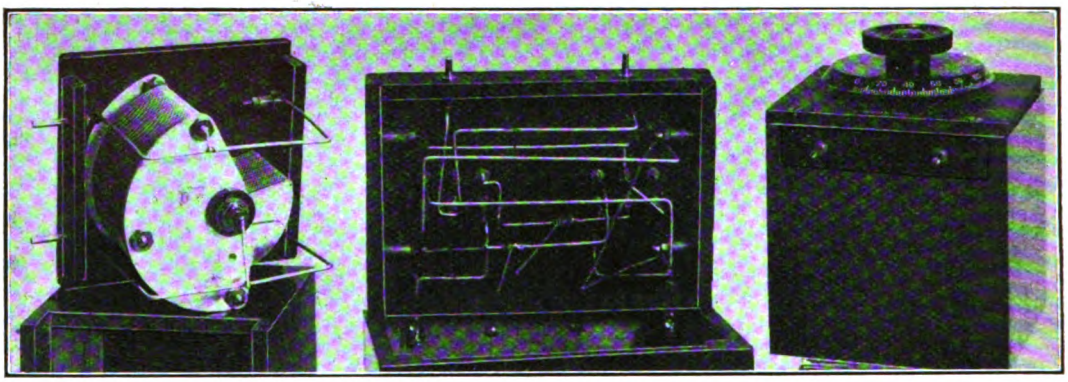

View of the condenser unit, the tuner unit, and of the condenser in its box.

Valve sockets are provided on the top and bottom strips of this unit. The aerial tuning condenser may be plugged in the lower sockets and the secondary tuning condenser in the upper sockets. When it is desired to couple the reaction coil with the aerial coil the plugs provided on the flexible leads from

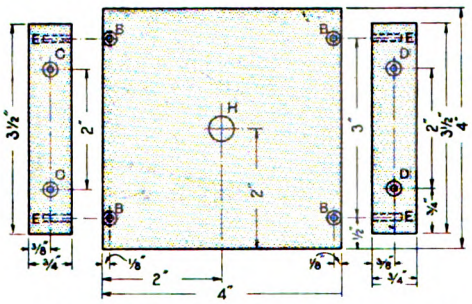

Fig. 4. Details of panel and side strips of condenser units. For drilling details see particulars given below Fig. 3.

the reaction coil unit (to be described later) are plugged in the sockets provided for the secondary circuit tuning condenser.

The condenser units are simply variable condensers mounted in boxes having ebonite

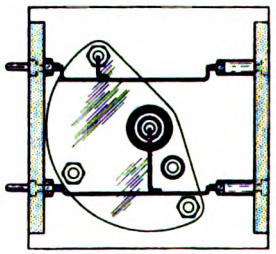

Fig. 5. Wiring of condenser unit.

strips, carrying two valve sockets on one side and two valve pins on the other side. One condenser has a maximum capacity of 0·001 microfarads, and may be employed to tune the aerial circuit; the second condenser has a capacity of 0·0005 microfarads, and is used for tuning the secondary circuit. Details of the boxes and strips and the wiring of the parts are given in Figs. 4 and 5.

RADIO POSSIBILITIES IN FINLAND.

Wireless development in Finland is not solely represented by the indefatigable efforts of **1 NA** and his confrères. Two active radio societies exist, the Finnish Radioforening and the Nuoren Voiman Liitro, the latter having a section, 100 strong, composed entirely of amateurs. The former body has over 600 members, and has as its objects the fostering of the amateur cause, providing assistance for professional experimenters and in all radio matters acting as an intermediary between the Government and the ordinary citizen. Broadcasting is likely to begin in the very near future and already several British firms have secured orders for the manufacture of receiving sets.

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COHERERS AND CONTACT DETECTORS.

Some references were made to coherers in the author's articles on "The Crystal Detector in Theory and Practice," published in this Journal recently. In the present article the subject of coherers and their relationship to modern crystal detectors is dealt with more fully.

By James Strachan, F.Inst.P.

THERE are three distinct electrical instruments in which the peculiar properties of "loose contacts" are made use of, and which, although nearly related, differ essentially in their mode of operation.

These are,

(1) The Carbon Microphone,
(2) The Branly Coherer, and
(3) The Crystal Detector.

In dealing with the theory of crystal detectors, I have so far ignored true coherer action and also microphonic action, because it was quite clear to me that they had nothing to do with rectification. Some modern writers on the subject of crystal rectification do not appear to be quite clear on this subject, with the result that their theories of rectification have been confused by the introduction of explanations of phenomena not directly connected with rectification. This confusion may be accounted for by the facts (1) that the modern crystal detector has been evolved from microphone and coherer types of apparatus and (2) that with the exceptions of Pierce and Tutton, whose suggestions I have developed into a rational theory of electronic action in crystal rectification, all other investigators have based their theories on molecular actions, such as are produced by heating effects, electrostatic and electrolytic reactions.

Further, Ettenreich* has confirmed the validity of the electronic theory of crystal rectification by his investigations of the time of reaction of the crystal detector, thus giving final and positive proof that the grosser movements of molecules or ions are not concerned in rectification. Apart from such modern evidence, however, it should have been quite clear from simpler observations that microphonic and pure coherer action are distinct from rectification because the latter is not essential to the functioning of either microphones or true coherers.

* *Wireless World* Correspondence, July 9th, 1924, page 431.

Historical.

The first practical application of a loose contact was in the microphone invented by Hughes about 1878. The first microphone had slightly oxidised metallic contacts, but Hughes soon found carbon contacts to be the best for the purpose. It should be noted here, however, that a few years later, when attempts were being made to produce a speaking microphone or microphone-telephone, one patent covered the use of galena and pyrites as the contact materials.

The failure of clean metallic surfaces to produce microphonic contacts was explained by the observations made by Stroh, that the passage of a current through a loose metallic contact caused cohesion of adjacent molecules, resulting in a permanent reduction of resistance so long as the contact was not disturbed mechanically.

The nature of microphonic contacts was thoroughly investigated by Shelford Bidwell (1883), who showed that in the case of carbon the variation of resistance at the loose contact was not accompanied by permanent molecular cohesion, as in the case of metals, thus confirming Stroh's observations. We thus see that long before the first contact detector was invented (1890), loose contacts involving the use of carbon, metals and metallic sulphides, had been employed and their nature investigated.

The first detector used for exploring an oscillating field was the Hertz spark-gap. In 1890, Fitzgerald discovered accidentally that by reducing the spark-gap to microscopic dimensions and placing a galvanometer in the circuit, a deflection of the needle was

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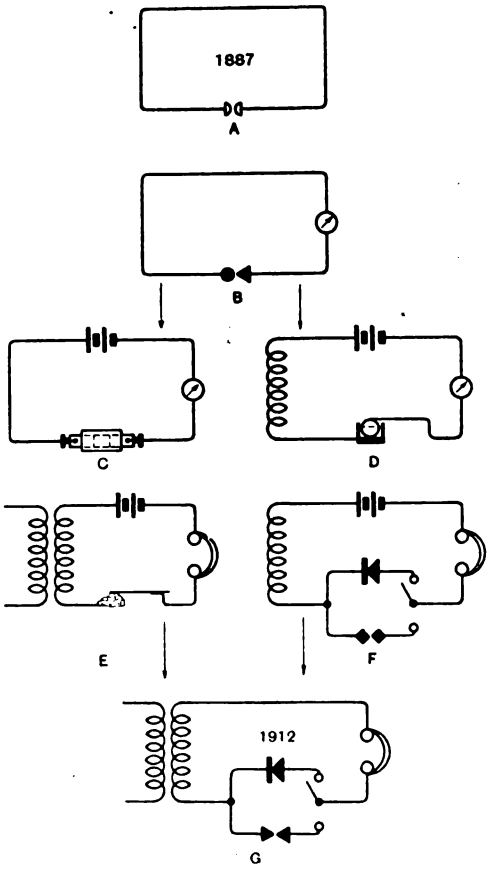
obtained. In this experiment the "spark-gap" was really a loose contact and rectification was obtained at the slightly oxidised metallic surfaces. This phenomenon was investigated by Lodge, who developed the idea of the loose-contact detector as distinct from the spark-gap.

In the same year (1890) Branly invented the first practical coherer operated by an applied potential. This consisted of a layer of finely divided metallic copper on a ground-glass surface in circuit with a Daniell cell and a H.R. galvanometer. In 1891 he followed this with his famous Branly tube or filings coherer, in which the copper film was replaced by a glass tube containing metallic filings or powder.

During the subsequent five years the experiments of Branly were repeated and investigated by physicists all over Europe, and many modifications of the Branly tube were devised, but in its simplest form it remained for a long time the most sensitive and practical detector available.

From this point the development of contact detectors proceeded along two distinct lines. The idea of the single-point loose contact was followed by Lodge and Castelli and later by Eccles, giving rise eventually in other hands to the modern single-point crystal detector. The idea of the multiple-point contact of the Branly tube was developed practically by Marconi, in whose hands the filings coherer reached perfection.

Diagram showing the Evolution of the Crystal Detector in 25 years.



A, spark gap (Hertz); B, microscopic spark gap = loose contact (Fitzgerald & Lodge); C, multiple-contact coherer (Branly); D, single-contact coherer (Lodge-Muirhead); E, multiple-contact carborundum detector; F, single-point film coherer and galena coherer; G, modern galena and perikon crystal detectors.

The comparative inefficiency of the best coherer, however, soon gave place to the single-point contact of the galena crystal detector.

The term "coherer" (which we owe to Lodge) was applied without discrimination to all the early forms of loose-contact detectors, which, it should be noted, were all operated by an applied potential from a local battery. The word "coherer" suggested a loose description of the mode of operation of these detectors which, by "coherence" of the loose contacts, effected a reduction of their resistance, thus allowing the current to pass from the local battery.

Theories of Coherer Action.

The early workers on contact detectors invented various theories to account for the cohering of the loose contacts. Branly was of the opinion that in addition to electrostatic attraction of the adjacent particles, the thin intervening layer of dielectric became a conductor under the influence of oscillations. Turner, Minchin and Appleyard showed that coherer action still took place when the air dielectric in a Branly tube was replaced by such substances as resin, gelatine and gutta percha, the metallic filings being immersed in these media. Haga (1896) was the first to observe through the microscope the actual bridging of the air dielectric film between two metal conductors in close proximity under the influence of a potential difference,

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a practical confirmation of the observations made by Stroh and Shelford Bidwell many years previously. Turner and others observed that the most sensitive coherers were obtained with certain easily oxidisable metals such as copper and aluminium, whence arose the theory that the variations in resistance of a coherer were due to the formation and disruption of oxide films. It was also observed that with such oxide-film coherers, actual repulsions of the loose contacts occurred so that the idea of "cohering" action was not quite adequate. More recently, as fully described and referred to in my recent contributions in this Journal on "The Crystal Detector in Theory and Practice," Eccles developed the thermal theory in explanation of the action of the oxide film coherer. Finally, in the same articles, I have shown that film coherers (both oxide and sulphide) are essentially identical in operation with crystal rectifiers and that rectification is associated with electronic movements. In this respect film coherers, whether oxide or sulphide, are distinct, in their mode of operation, from true metallic coherers.

Classification of Coherers.

All the early forms of coherer detectors were of the "non-self-restoring" type, the cohering of the loose contacts being permanent until the sensitive condition was restored by some automatic mechanical arrangement. The Branly tube type of coherer was "decohered" by a tap from an electro-magnet worked through a relay. In the so-called "self-restoring" type of single contact coherers with carbon-mercury and steel-mercury contacts (Castelli and Lodge-Muirhead types), similar results were obtained in decoherence by taking advantage of the electro-capillary properties of mercury and rotation of the contact point. This division of coherers into "self-restoring" and "non-self-restoring" types was arbitrary. The first true self-restoring detector was arrived at when carborundum powder was used instead of metal filings in the Branly tube. This was an advance but it was really a rather inefficient crystal detector and led back to the single contact type of detector.

When it became recognised that oxide and sulphide films on metal were not only better as detectors than clean metallic contacts, but that with a proper thickness of the oxide or sulphide film and a single point of contact rectification was effected, the rapid evolution of the modern crystal detector became possible.

Distinction Between Metal Coherers and Film Coherers.

Experiment with the powerful oscillations of B.B.C. telephony brings out clearly the distinction between true coherer action with clean metallic filings, and that of film coherers in which the metals used are oxidised or sulphidised. In the former, when care is taken to exclude atmospheric influences by immersion of the contacts in oil or in an inert gas, the Branly tube will not respond to telephony. Film coherers, however, rectify and bring in telephony. In the latter the degree of rectification depends on the thickness of the film and the resistance of the contacts. With a low resistance multiple-point contact (such as a Branly tube with very slightly oxidised filings), the degree of rectification is very small. With a suitable thickness of film and a single-point contact the degree of rectification is, in some cases, quite as good as with a crystal detector. From numerous experiments it appears quite certain that the increased sensitivity of very slightly oxidised surfaces in the early coherers was due partly to the slight degree of rectification obtained and partly to the fact that such contacts responded more rapidly to mechanical decoherence in the reception of oscillation trains.

Nature of the Reactions at Loose Contacts.

During the writer's exhaustive experiments with contact detectors of all kinds, he was able to distinguish between three types of reaction, as indicated above, at loose contacts, *viz.* :—

(1) Microphone action.
(2) True coherer action.
(3) Rectification.

From these experiments it appears that:

(1) Microphonic action occurs at any loose contact having a variable resistance but without cohesion of the contact molecules. Substances giving microphonic contacts are carbon, certain metallic oxides and sulphides and intimate mixtures of finely divided metals with inert substances. The action is molecular.

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(2) True coherer action takes place perfectly only between clean metallic contacts and is accompanied by cohesion of the contact molecules. The cohesion produced by a feeble current is destroyed by a mechanical shock. With very slightly oxidised metallic contacts the degree of cohesion is much less and de-cohesion more easily effected. The action is molecular, and most probably electrostatic in nature.

(3) Rectification occurs at loose contacts between metals and certain badly conducting substances, chiefly oxides and sulphides, or between the latter themselves. The action is electronic but is accompanied by attraction and repulsion of the contact molecules, giving rise to molecular vibrations and microphonic action. The best degree of rectification with the least microphonic action is obtained between a rigid metallic point and a rigid rectifying substance. When the contact is made between rectifying substances (without a metal point) held in position by springy metallic fittings, microphonic action is most pronounced and the degree of rectification is not so perfect.

RECTIFICATION A SURFACE PHENOMENON.

In the electronic theory of rectification advanced recently by the present writer, stress was laid upon the fact that this reaction is a surface phenomenon. This is most clearly brought out in experiments with single-point film coherers, which latter should really be described as film rectifiers as they are *not coherers*. Round was the first to point out that crystalline structure is not essential in rectifying substances. Many amorphous powders under proper conditions will rectify. It cannot be denied, however, the orientation of the molecules in crystalline rectifiers determines the most efficient degree of rectification at the surface, and that the conditions under which amorphous substances act as efficient rectifiers are such that they become or behave as crystalline bodies.

For example, galena or lead sulphide may be used as a detector in three different forms, using a metal point at the loose contact.

(1) Crystalline, as in the modern crystal detector.
(2) As a thin film deposited in " metallic " form on a metal surface.
(3) As an amorphous powder lying loosely on a metal plate.

(1) and (2) rectify without an applied potential while (3) requires an applied potential from a local battery.

In (2) the galena film is crystalline and probably pseudomorphous after the crystalline structure of the metal.

In (3) the application of the applied potential induces crystalline conditions at the loose contact and rectification persists after the applied potential is removed, so long as the loose contact is not disturbed mechanically. In each of the three cases the direction of the rectified current is the same as that of the natural galena in a pure state, *viz.*, galena — *ve*, " catwhisker " + *ve*.

While the conditions under which (2) and (3) are exactly those of the so-called film coherers, it should be apparent that the nature of the reaction is the same in each case and is produced at the surface of the contact molecules. In this connection it should be remembered that there is really no difference in the ultimate structure of most amorphous substances as compared with their crystalline forms. The difference lies in the orderly orientation of the crystalline form. This order may be natural, it may be pseudomorphous, or it may be acquired under the conditions described above.

A film coherer, whether oxide or sulphide, is really a good conductor coated with a film of rectifying substance, and as rectification is a surface phenomenon, a film of the requisite thickness is all that is required.

In my theory of rectification I postulated that the outside film of a crystal alone was concerned in the rectification and that this film possessed different physical properties from the interior molecules. This statement of a fact hitherto unrecognised has received unexpected support from an entirely different quarter, in Professor Desch's work on the surface-tension of crystals recently read at the British Association meeting in Canada.*

PRACTICAL POINTS.

So far this description of coherers and their relationship to the modern crystal detector is largely historical and theoretical, nevertheless useful, I hope, in clearing up some of the confusion that has surrounded the subject.

The question remains as to whether anything of practical importance may yet arise

* " The Crystal Surface," by Prof. C. H. Desch, Mathematics and Physics Section of the B.A.

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out of the coherer. The modern crystal detector has been evolved from the coherer—is there any other line of research in this subject offering prospects of interesting work?

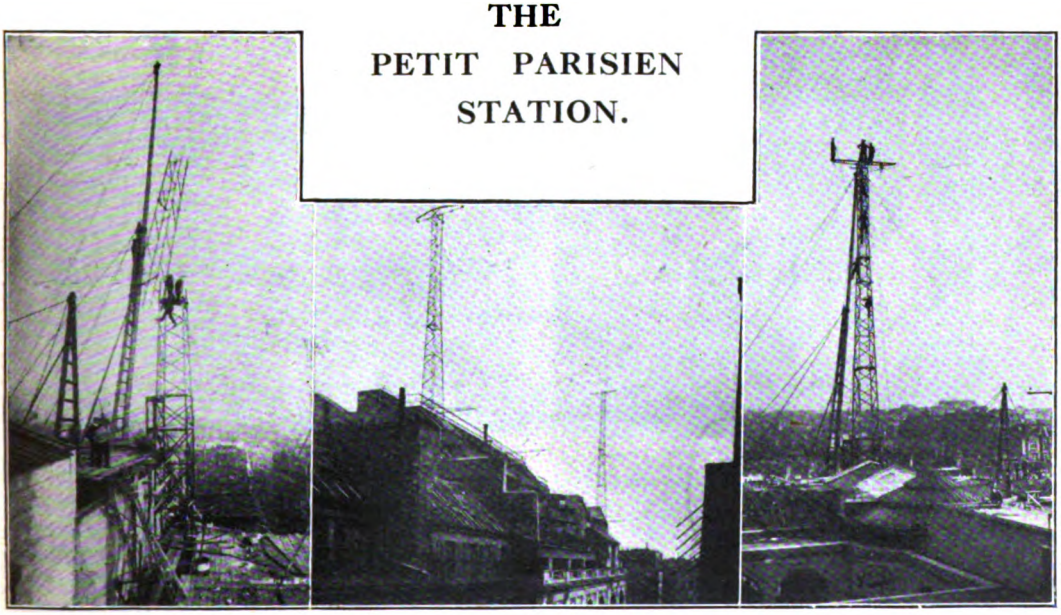
With regard to pure coherer action with pure metals, the most promising line of research lies in experiments with colloidal suspensions in non-conducting liquids.

With reference to microscopic effects, while we should endeavour to reduce these as much as possible in the crystal detector by proper design of apparatus, there is an interesting field in the opposite direction, *viz.*, by developing the microphonic reaction to the utmost so that the rectifier becomes also the reproducer of telephony. Leslie Miller's "Thermophone," described several years ago, is a step in this direction. The combination of crystal rectification with speech reproduction and without a magnetic circuit is enticing.

In a subsequent contribution I shall deal with some practical forms of "film coherers," all of which are much better than the best of the early forms of this type of apparatus, and of considerable theoretical interest, while some of them are not inferior to the best crystal detector, although more difficult to manipulate.

BROADCASTING IN PARIS.

THE PETIT PARISIEN STATION.



The erection of the aerial masts is shown in the above pictures.

Few broadcast listeners in this country possessing valve receivers are unfamiliar with the transmissions from at least one of the Paris broadcasting stations. In this article first-hand information is given concerning the equipment of the most recently erected station in the French capital.

UNLIKE London, Paris has several broadcasting stations in operation, and although Eiffel Tower, **PTT** and Radio-Paris have been well-known for a considerable time, public interest is now being directed in a large measure to the more recently opened station, which is owned by the *Petit Parisien*, the largest French daily newspaper, which claims a total circulation of about 1,600,000.

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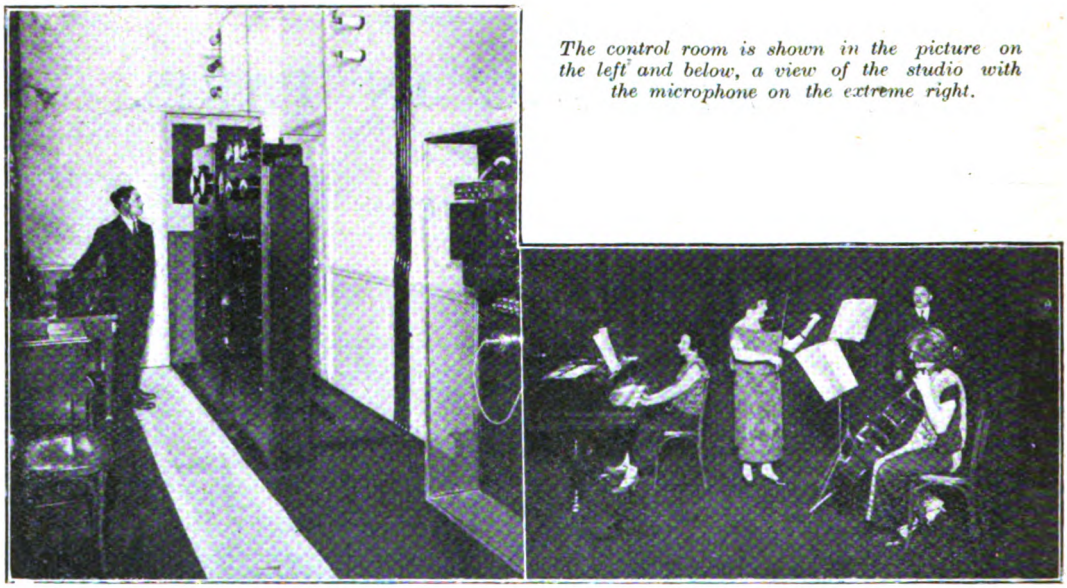
The station is located in the building occupied by the offices of the journal itself on the Rue d'Enghien, in the centre of the busiest thoroughfares of Paris. The aerial masts were erected on the roof of the building, a task which proved very difficult, since the roof, or rather roofs (for it is actually supported on two), were not designed to carry this additional weight. The two masts are uniform in pattern, and since they are erected on the roofs of two separate buildings which differ in height, the aerial is not quite horizontal. The height of one roof is 77 ft., whilst the other is 74 ft. Each mast weighs 2½ tons, and is 70 ft. high.



The control room is shown in the picture on the left and below, a view of the studio with the microphone on the extreme right.

The aerial is about 90 ft. in length, and consists of three horizontal parallel wires. The radiation from the aerial is stated to be 500 watts, and the input is 1½ kilowatts. The station, as is generally known, works on a wavelength of 340 metres.

A counterpoise is used instead of a direct earth connection, and this is formed of ten wires about 120 ft. long, comprising a sort of " mat " 30 ft. wide under the aerial. The employment of the counterpoise was found to obviate interference from the large number of motors and other electrical machinery employed in connection with the newspaper printing presses.

The actual apparatus is designed by the Western Electric Company, and is of the same type as that at present used at the station **PTT**. A Western Electric carbon diaphragm microphone is used, and an amplifier for amplification between the microphone and the modulator valve. The power for the transmitter is furnished by the city power mains, two generators supplying plate and filament currents for the valves.

The illustrations which we reproduce here are of interest. Those showing the erection of the masts indicate clearly the difficulties which had to be contended with in putting up these on the roofs of the buildings. The centre photograph shows the completed mast towers and aerial. Other photographs on this page show the control room and the studio. It will be observed that the studio is draped in the usual manner now adopted in broadcasting in order to eliminate echo effect and otherwise improve the acoustic properties of the room.

In France public interest in this station is growing very rapidly, but is not confined to that country, since the station can be heard over a wide area.

Numerous reports from amateurs and others are received from Scandinavia, Algeria, Spain (including the South of Spain), and from Germany, whilst reception in England is commonly reported from many parts.

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THE INDUCTANCE OF LATTICE COILS.

A rapid method is outlined for the calculation of the inductance of lattice-wound coils which extends the graphical method of Mr. W. H. Nottage, in his "Calculation and Measurement of Inductance and Capacity," the second enlarged edition of which has recently been published.

By J. G. Hart, B.Sc.

RECENT articles show that a need is being felt by experimenters for more exact methods in the measurement of the electrical constants. Unfortunately this frequently involves more than the average mathematical knowledge and more time than can be spared. Nevertheless it is inevitable that as a science progresses more exact processes of calculation are needed and in this connection the following words of Lord Kelvin should be taken to heart by experimenters: "When you can measure what you are speaking about and express it in numbers, you know something about it, but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind."

It is to be hoped that in time all manufacturers will quote the inductance values of their coils.

Lattice coils are easily made and are efficient, as the spacing between layers renders them of reasonably low self-capacity.

The formula $L = 0{\cdot}001\ \pi^2\ (N^2\ d^2/l)\ K^1$ microhenries (on page 19 of Mr. Nottage's book*) gives results rather too high, especially for the first few layers, but is sufficiently accurate for a first approximation. When a closer result is required it is better to find the self-inductance of each layer and the mutual inductance between layers. The method outlined below shows how to arrive at these values by a graphical method with the minimum of labour; it is in fact only necessary to calculate

(*a*) Self-inductance of first and last layers as solenoids,

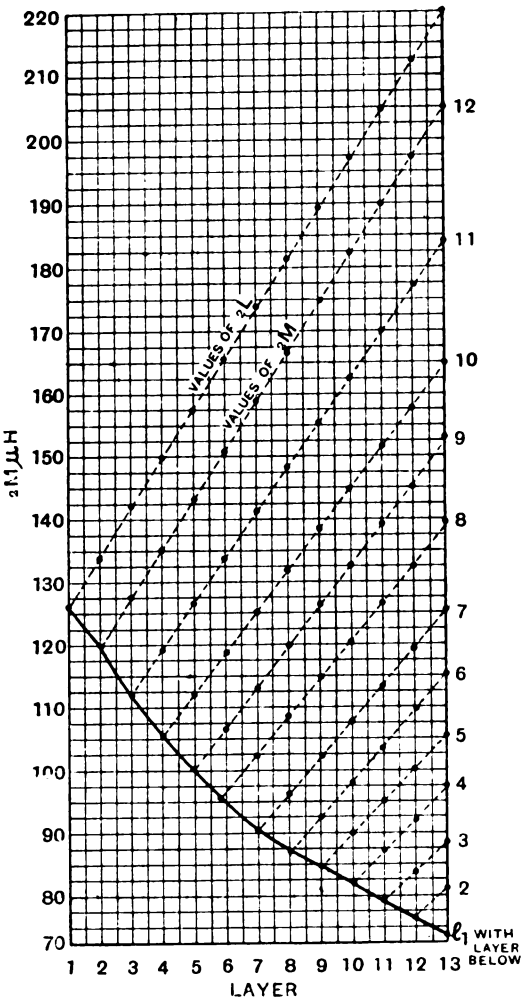

Fig. 1. Mutual inductance between layers of lattice coils wound with No. 32 D.C.C. wire; 30 turns per layer.

* Published by The Wireless Press, Ltd., price 7/6 net.

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(*b*) Mutual inductance between first and second, first and third, and so on.

With a coil having 16 layers, therefore, it is only necessary to make $2 + 15 = 17$ calculations instead of $17 + 17\,(16) = 289$, the reason being that the graphs show that it is sufficiently accurate to assume a straight-line law for the remaining values.

The calculation of the mutual self-inductances are best carried out by Mr. Nottage's graphical method (page 37 of his book) and it is found that it is sufficiently accurate to arrange the numbers of turns N_1 in each layer in such a way that there are $\sqrt{N_1}$ groups or the nearest integer to that value, *e.g.*, if there are 30 turns it suffices to take 5 groups of 6. This can be readily seen by taking different groupings and plotting a graph for the values of M_r; it will be seen that the curve becomes asymptotic where the number of groups is approximately $\sqrt{N_1}$.

The majority of the work involved is that in the calculation of M_r values and the graphical extension saves the majority of these being separately determined. Similarly the calculation of $2M_{1n} = 0{\cdot}002 N_1 N_2 \sqrt{R_1 R_2}\, M_r$ microhenries is also saved as the values of $2M_{1n}$ are necessary only for the end values indicated above.

Figure 1 shows the relation between the various values of $2M$ and $2L$; the thick lines join the minimum number of points which have to be determined in the usual manner and the dotted lines show those which can be predicted from those already known. If great accuracy is desired it is better to calculate also $2M$ between the last layer and each of the others to give the exact slopes of the dotted lines which diminish slightly as we reach the bottom of the graph. All that remains then to find the total inductance of the coil is to sum up the values of L and of $2M$ between each pair of layers. This diagram incidentally shows the relation between L and M.

Figure 2 shows the final result compared with that obtained by using the Coursey formula.

The example taken was that of a lattice wound 32 d.c.c. coil on a cardboard former of approximately 5 cm. diameter—the axial length was 1·67 cm. for 30 turns, and the radial increase per layer was 0·11 cm.

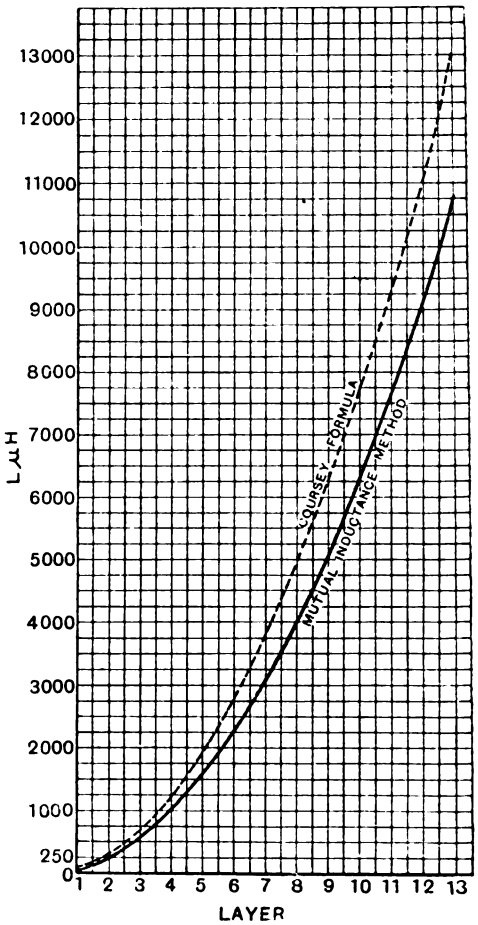

Fig. 2. Inductance of lattice coils, No. 32 D.C.C.; 30 turns per layer.

Similar results have been worked out for 26 d.c.c. wire and the curves follow the same law.

The corrections for spacing have been found to be sufficiently small to neglect, being only 22 microhenries for a coil of 15 layers.

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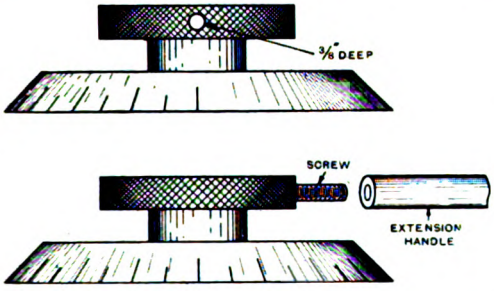
READERS' PRACTICAL IDEAS.

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Simple Extension Handle.

WHEN tuning to distant stations it is a well-known fact that an extension handle attached to the knob of the variable condenser is a great help in avoiding hand capacity effects, while the long handle greatly facilitates critical adjustment. One of the easiest methods of fitting an extension handle consists of tapping a hole into the side of the knob and inserting a piece of



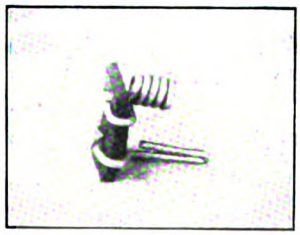
A simple method of connecting an extension handle.

6 B.A. threaded rod. The projecting piece of rod is made to engage on the tapped ebonite handle, which may be about 6 ins. in length.

C. S. B.

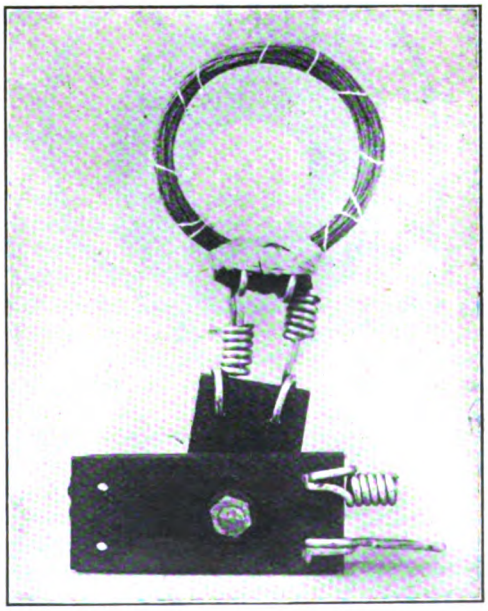
Interchangeable Coil Mounting.

IT is doubtful if adjustable coil mounting can be constructed to a more economical design than that shown in the accompanying illustration. The sockets are made by twisting No. 16 wire tightly round a piece of ⅛ in. brass rod, whilst the stem consists of a hook-shaped bent wire. Attachment is made to the ebonite merely by putting the wire through a hole and the result is a coil holder of rigid construction which can be relied upon to make good contact.



Showing how bent wire can form a good coil mount.

Two coils can be coupled together by means of a swivelling joint built up from



A two-coil holder with provision for variable coupling.

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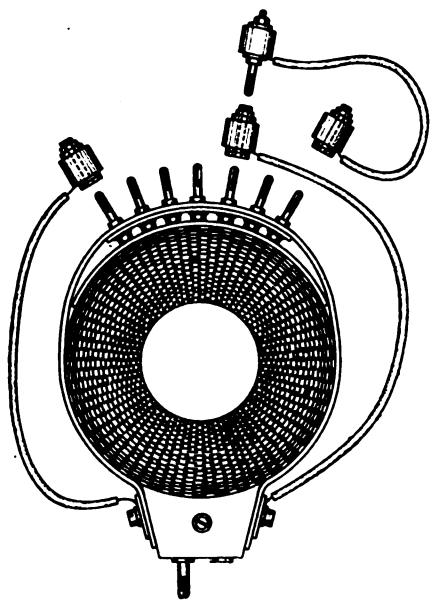
a piece of threaded rod, two nuts, a few washers and a split spring washer. The mount for attaching to the coil is shown in the smaller illustration.

G. W. A.

Tapped Plug-in Coils for Long Wavelengths.

THE inefficiency which may result by using tapped coils is not so serious on an inductance entirely devoted to long wave tuning as in the case where a short wave coil is loaded up to receive on the longest wavelengths. As the large plug-in coils are expensive and a considerable number of them may be required to cover the wave-band of 2,000 to 20,000 metres, it will be found useful to tap out a large inductance.

The method of making the tappings is shown and the first and last of the plugs connects to the beginning and end of the winding so that any portion can be put in circuit by means of the two sockets attached



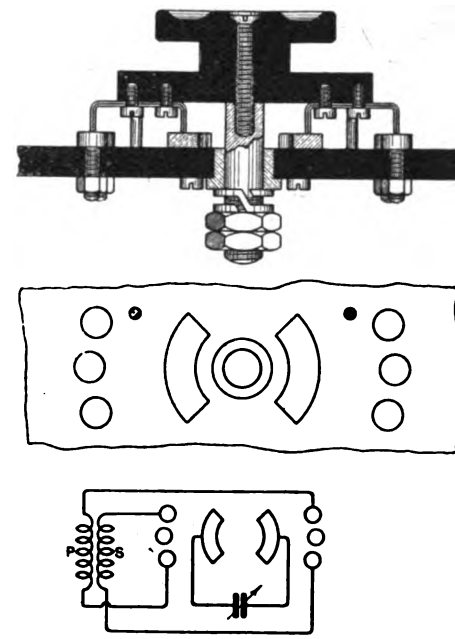
The coil can be tapped as desired, and dead-end turns can be short-circuited.

to flexible leads joined to the base of the coil holder. The pegs are the usual valve legs inserted in a piece of ebonite 1/32 in. in thickness, whilst another piece of ebonite is placed over the winding to prevent the nuts damaging the insulation on the wire. A short circuiting plug is shown and this will be found useful for extending the wavelength range, by connecting portions of the coil in parallel.

H. M.

Double Pole Panel Switch for H.F.

THE accompanying drawing shows all the necessary constructional details for making up a switch of high efficiency for use in high frequency circuits.



Design for an efficient panel switch and a suggested application.

A switch of this sort has many applications and one way in which it can be usefully employed is shown in the circuit diagram. Here the tuning condenser is transferred from the primary to the secondary winding, and if the coupling between the primary and secondary is not excessively tight the tuning range may be extended in this manner when the two windings consist of a different number of turns.

A. L.

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LOW CAPACITY COILS

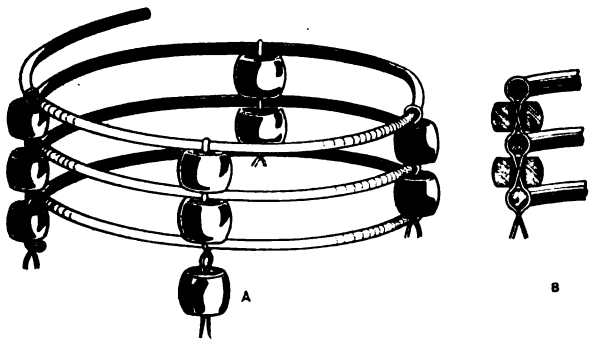
A NOVEL METHOD OF SUPPORT

By P. J, Parmiter.

In the design of low capacity inductance coils for short wave reception such as those described in *The Wireless World and Radio Review*, Vol. XIII, p. 613, drilled ebonite strips are used to support the turns. This method of construction involves a considerable amount of accurate drilling, and the subsequent assembling is a rather difficult matter as the ebonite strips are liable to split when manipulating the relatively stiff wire through the holes.

Now a No. 16 gauge wire is practically self-supporting, and therefore, as the principal use of the strips is to keep the coils in shape, there is no considerable strain imposed upon the supports when the final assembling is completed.

Another way to achieve the same result with the advantages of greater strength and unbreakable construction is as follows.



Bead spacers for low capacity coils.

First wind the coil of the desired dimensions and number of turns, using say a No. 16 gauge wire (which may be insulated if so desired) upon a firm yet somewhat resilient mandril. The writer uses a length of strawboard tubing, 3½ ins. diam. and ⅜ in. thick.

After winding, the wire is sufficiently springy to render its removal from the former an easy matter.

The loose coils are now secured by means of cotton or thin string, and electrical insulating beads in the following manner.

A doubled length of the string or silk is passed over the top turn, a bead is then slipped over the free ends of the string and pushed up close to the wire. The ends of the string are separated so as to embrace the next turn, after which they are brought together and another bead slipped on, this process being continued until all the turns have been secured. The free ends of the string are then tied and cut off.

This is repeated four times at intervals of 90 degs. around the circumference of the coil, or with small coils three rows at intervals of 120 degs. will suffice to render the coil both rigid and unbreakable.

If the turns are required to be closer together than the thinnest available beads will permit, they may be replaced by knots in the string, or even by crossing thicker string, lattice pattern, between the turns.

The ends of the coils may be joined to the standard plug contacts. Similar coils may be wound for transmitting inductances, in which case one long coil may be subdivided into a number of sections. The ends can be connected in series by single plugs and sockets, which are staggered around the built up inductance. In this way the inductance of the coil may be adjusted as desired by adding or by removing the "units" or small coils of which it is composed, the plug and socket connections rendering this an easy matter.

If the final inductance is too long to be self-supporting it can be strengthened by a skeleton former of insulating material.

Tappings can be taken from the plug and socket connections by means of clips or by soldering on short leads.

C

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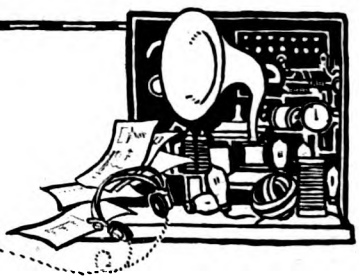
NEW APPLIANCES.



The Anti-phonic Valve Holder.*

The valve holder is sketched in Fig. 1, where A is a base provided with fixing holes B, and C is the holder which contains the valve sockets. The holder C is fastened to the base by four springs D, which are secured at one end to the valve sockets, and at the other to the base by screws E. The valve is thus supported on springs, which absorb mechanical shocks and protect the filament. The springs are of sufficient strength to withstand straining when a valve is inserted or withdrawn.

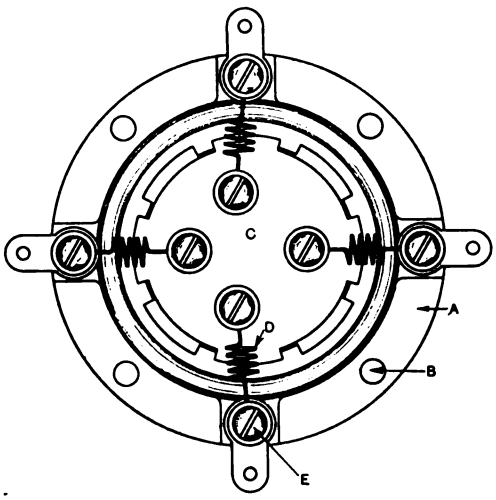


Fig. 1. *A sketch of the underside of the holder showing more clearly the principle adopted.*

The risk of burning out the filament by inserting the valve in the wrong position is eliminated, the sockets being sunk below the surface of the holder.

* Messrs. Burndept, Ltd.

The valve holder is 2⅛ ins. in diameter, and is suitable for mounting on a baseboard, or may be mounted on the rear side of the panel, and will be found very useful in portable receivers as well as in receivers employing dull-emitter valves, particularly those of the class which take a filament current of 0·06 ampere.

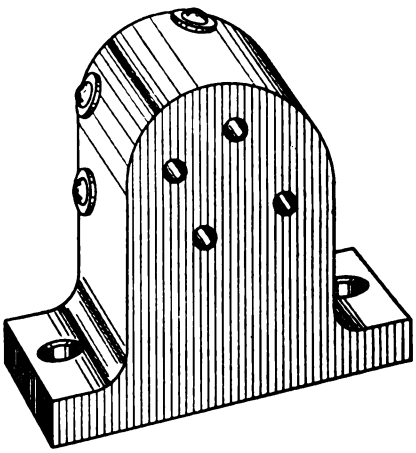


Fig. 2

The Aermonic Valve Holder.

The valve holder sketched in Fig. 2 has been designed for screwing to the back of the panel. The base of the holder is 2 ins. long by 1 in. wide, and the centre of the valve, when mounted in the holder, is about 1¼ ins. from the edge of the base.

The material of the holder appears to have satisfactory insulating properties.

To remove the possibility of the valve being inserted in an incorrect position, the brass sockets terminate about ⅛ in. from the surface. Special attention has been given to the arrangement of the sockets from the point of view of easy wiring.

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EXPERIMENTAL EQUIPMENT AT 2DX.

By W. K. Alford.

A RATHER interesting indication of the remarkable advances of amateur wireless during the last ten years may be gained by turning up the October 1914 number of *The Wireless World*. The equipment of **TXK**, now **2DX**, is therein described, with a photograph of the apparatus.

Gone is the 400 cycle spark set whose range seemed to vary inversely as the power input; likewise the receiver with its loose couplers, crystal detectors and enormous variable condensers, though this receiver achieved the somewhat noteworthy reception of the old Marconi spark station at Glace Bay, Nova Scotia, on 9,000 metres, hence the enormous "cheese box" inductance in the left centre of the photograph.

A point of interest lies in the fact that a De Forest Audion valve was obtained at the end of 1913 and used quite successfully, but since the principle of regeneration was unknown at that time little advantage was gained over the crystal receiver.

The Present Transmitter.

The general arrangement of the transmitting gear is shown in the photograph, which at first sight gives an impression of inadaptability.

However, the whole system is capable of the most flexible re-arrangement for experimental purposes, bus-bars and terminal boards being provided at the back of the panel, which is quite open.

This method, incorporating tidiness with efficiency, appeals to the writer, and pickle jar and jampot apparatus does not find its place in the equipment.

Lastly, and not least, safety in operation has been considered, as fairly high voltages, between 4,000 and 5,000, are available. Nobody who is continually receiving shocks from the apparatus can maintain a mental equilibrium consistent with fruitful research.

The investigations proceeding at the time of taking the photograph concerned the application of the master oscillator system to short wave transmissions.

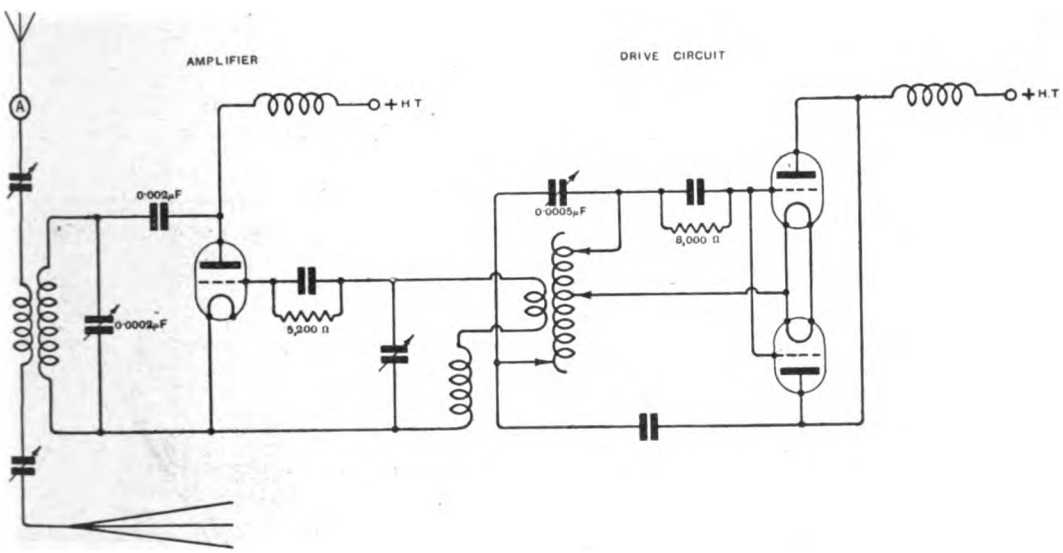

Fig. 1. Diagram of the transmitter circuit now in use.

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The aerial, closed circuit, and grid circuit inductances are seen at the top right, and are wound with 6 S.W.G. H.C. copper wire.

The master oscillator or drive circuit inductances are seen at the left, and although rather more than necessarily large, happened to be available and function perfectly.

The high potential is rectified by two Mullard U 50 rectifying valves, which handle up to 3,000 volts at a maximum of 0·12 amperes.

Four Amrad " S " tubes W4,000 are being tried in the rectifying circuit. These tubes have a remarkable rectification characteristic,

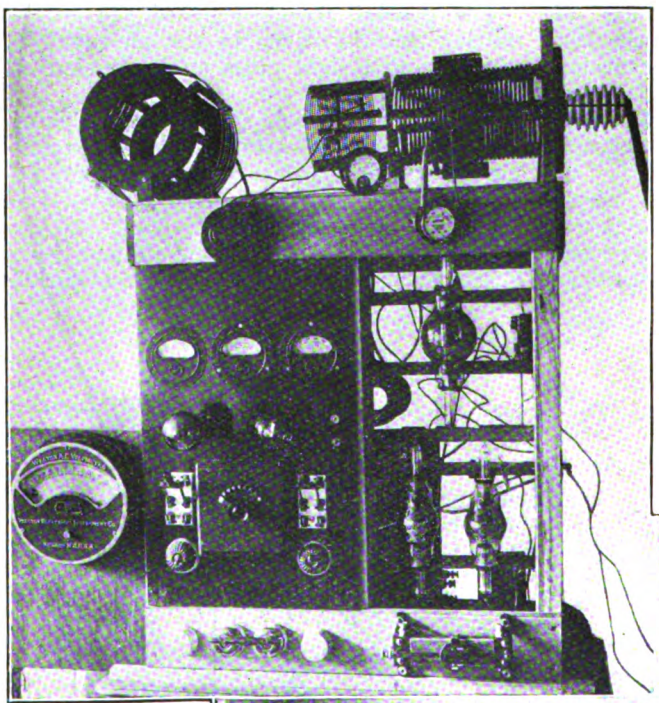

Fig. 2. An illustration of the Transmitter panel. Everything is arranged for easy access for experimental connections.

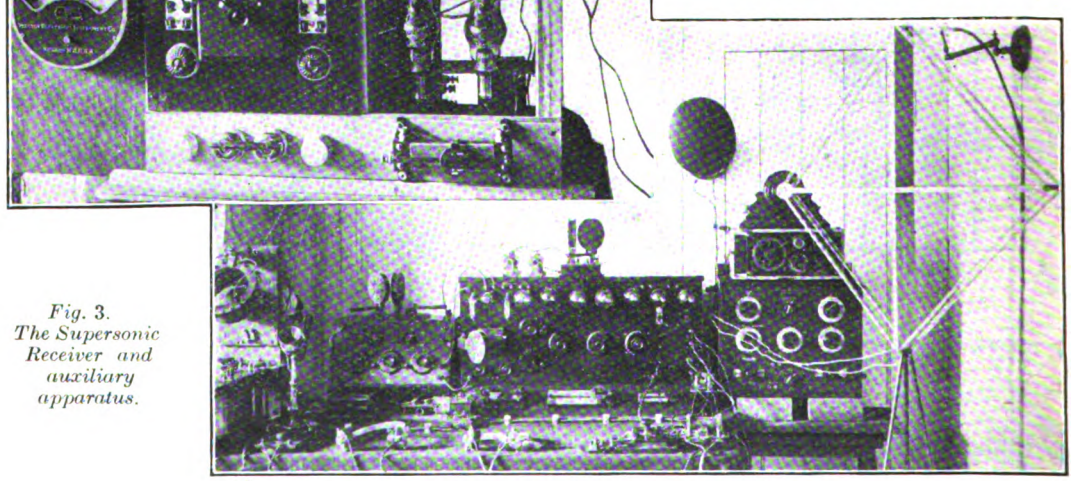

Fig. 3. The Supersonic Receiver and auxiliary apparatus.

This drive circuit employs two A.T. 40 valves in parallel, the amplifier being a Mullard 0-150, rated at 2,000 volts anode potential, and requiring 10·4 volts at 4 amperes for the filament.

The anode potential and filament lighting current is provided from a Zenith transformer rated at 160 K.V.A.

have an extraordinarily small " back flow," and pass large currents without any detriment to their life or efficiency.

The complete circuit, operating at the moment from 70-120 metres, is shown in the accompanying diagram (Fig. 1).

The overall efficiency is not as high as might be desired owing to unavoidably long

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aerial and counterpoise leads, one ampere of high frequency energy being transferred to the aerial with an input of about 40 watts to the main amplifier valve.

wave transmissions are looked forward to with great interest during the coming winter.

The Westinghouse Broadcasting Station, **KDKA**, operating on 53 metres, is received at tremendous strength, as were also the calibration waves sent out from the Eiffel Tower, Paris, on 25 metres.

After using the superheterodyne one must pause to admire the wonderful patience and skill displayed by the exponents of the "detector and one step" (obnoxious phrase) on short wavelengths. The mental and physical strain must be awful.

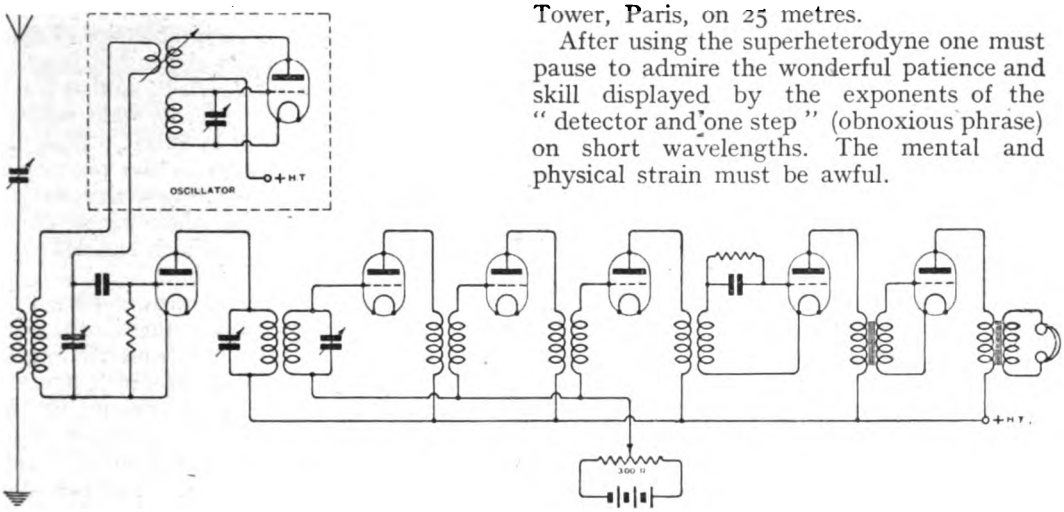

Fig. 4. Skeleton diagram of the circuit of the receiver.

THE RECEIVER.

For short wave reception an Armstrong supersonic heterodyne (Fig. 4) is employed, using up to ten valves, and has proved aighly satisfactory in operation. Uniform omplification, with the characteristic ease of operation, being obtained as low as 20 metres, and by its use the investigation of short

THE AERIAL.

The aerial is an eight-wire cone, tapering from 4 ft. 6 ins. to 6 ins., 47 ft. long, and 55 ft. in average height.

The counterpoise is an eight-wire fan-shape, and is untuned, its dimensions having been altered to obtain the best results on 100 metres and less.

EFFICIENT REACTION.

By H. STOPHER (**5 GF**).

ONE frequently encounters the case in home constructed sets in which great attention has been paid to the tuning arrangements and general wiring, but little or no thought given to the design of the reaction system, there appearing to exist a prevalent idea among many constructors that any coil which can conveniently be coupled to the A.T.I. will serve as a reaction coil, the only stipulation being that it must make the set oscillate. As in the majority of receivers the reception of weak signals depends largely upon the feed-back effect which is obtained by the use of reaction, the correct functioning of this portion of the circuit is of as much importance as the design of the tuning system.

The chief trouble experienced is overlap in reaction. Despite all that has been written regarding this phenomenon, in the technical press, the author has seen few home-constructed sets in which absolutely no overlap is present. Overlap is always indicated by the circuit commencing to oscillate with

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a pop when the coupling is tightened and the degree of coupling at which oscillation starts does not coincide with that at which it stops. The space intervening between these two points may only be very slight or it may be very pronounced but its presence even in a very small degree renders it almost impossible to obtain just that degree of regeneration necessary to read some extremely faint signal.

Overlap can be entirely eliminated by varying the filament current, the high tension voltage and the grid leak preceding the detector valve. In the case of a two or three-valve receiver with only one pair of H.T. terminals, it is often inconvenient to vary the plate potential and providing this is not excessive for the valves in use, the overlap can generally be eliminated by the use of a variable grid leak. As, however, the detecting properties of a valve vary enormously with different values of grid leak, it is best if possible to adjust the H.T. voltage of the detector valve and to obtain fine adjustment through the agency of the filament rheostat. When correctly adjusted it should be difficult to tell at what point of the reaction coupling oscillation starts and stops, assuming that the circuit is quite quiet and no signals are being received.

A trouble which is closely allied with overlap but which has very many other disadvantages, is the use of too large a reaction coil. It should never be necessary to use more turns of wire on the reaction coil than are included in the grid circuit. A large reaction coil will usually work as far as generating oscillations is concerned, but the tuning of the set suffers and it will generally be found that the set refuses to oscillate below the natural wavelength of the reaction coil. In the majority of cases, inability to oscillate on short wavelengths may be traced to this cause. A coil of 12 to 14 turns with reasonably tight coupling is ample for wavelengths up to 200 metres, but sets employing as many as 50 turns are frequently encountered.

In addition to the general inability of a set to oscillate below the natural wavelength of the reaction coil, two other important disadvantages accrue from making this coil too large. Firstly, the tuning of the set will vary enormously with any slight adjustment of the coupling. The disadvantages of this are obvious. Secondly, it will be necessary continually to adjust the reaction when varying the A.T.C. On most receivers best C.W. signals are generally obtained when the set is oscillating weakly, and when varying the A.T.C. from minimum to maximum the reaction coupling may have to be increased by as much as 45 degrees to keep the circuit just oscillating, if an unsuitable size of reaction coil is used. Coils either too large or too small both give this effect, so that if it is desired to tune over a fairly wide range a tapped reaction coil is essential. With the correct number of turns in the reaction it should only be necessary to vary the coupling a few degrees over the whole range of the aerial tuning condenser, which enables rapid searching to be carried out.

A three or five-plate condenser across the reaction coil is of great assistance in obtaining very fine adjustment and frequently enables weak stations to be received which it would be almost impossible to get without it. Its use, however, may cause complications if the reaction coil becomes tuned to the same wavelength as the aerial circuit, as oscillation may then become somewhat difficult to control. The reaction coil should in all cases be connected directly next to the plate of the valve, any other apparatus such as telephones, L.F. transformers, etc., coming afterwards. The author once experienced a case in which persistent refusal of a receiver to oscillate below 250 metres was traced to the first intervalve transformer having been placed between the plate of the detector valve and the reaction coil. The capacity between the primary and secondary windings was thus in shunt across the plate and filament of the valve and was sufficient on the higher frequencies to stop the valve oscillating.

Difficulty in getting a set to oscillate may also be caused through the 'phones transformer or other apparatus in the plate circuit of the valve not being shunted by a sufficiently large condenser to by-pass the H.F. circuits. Intermittent and unsteady oscillation may be due to variations in the internal resistance of a bad or aged H.T. battery. A 2 or 4 mfds. condenser across the battery will generally cure this trouble, besides generally quietening the circuit. A bad grid leak can also be responsible for unsteady oscillation. On the very short waves, around 100 metres, the set will probably refuse to oscillate if the tuning circuits are wound with too fine a gauge wire.

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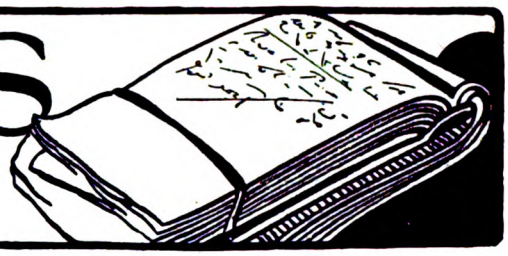
NOTES & NEWS



Crystal reception of **5 XX** without an external aerial is reported by a French amateur at Charenton, near Paris.

* * * *

Whaling vessels in the North Sea are adopting the Marconi Direction Finder as a means of locating each other in fog and darkness.

* * * *

It is understood that from 10 p.m. onwards this evening (Wednesday) the Election results will be broadcast. Details as to the state of the Parties will be given every hour.

* * * *

A course of University lectures is being broadcast from **WJZ**, the Westinghouse station in New York. Fifty-four lectures, each of twenty minutes duration, covering eight subjects, will constitute the "Fall" term.

* * * *

". . . the nation which makes the freest and most systematic use of broadcasting will be the one to take the foremost place intellectually and industrially."—Mr. A. R. Burrows, in his new book, "The Story of Broadcasting."

* * * *

CAPTAIN ECKERSLEY'S TRANSATLANTIC SPEECH.

Numerous readers report reception of the speech of Captain Eckersley, which was broadcast from **WGY**, the General Electric Company's station at Schnectady, New York, in the early hours of Sunday, October 12th.

Excellent reception was reported by Mr. Crewe of Golders Green, whilst Messrs. Bathurst and Martin, of West Croydon and Worksop respectively, report clear reception of the speech on one valve.

SWISS BROADCASTING TRIALS.

Preliminary trials from the new Swiss Broadcasting station at Hoengg, near Zurich, have proved very satisfactory and signals have been reported in both England and Sweden. A Western Electric transmitter is employed, operating on a wavelength of 650 metres. It is probable that the wavelength will, however, be altered owing to the interference caused by marine and coastal signals.

GERMANY'S BROADCASTING ANNIVERSARY

To-day (Wednesday) Germany celebrates her first anniversay of broadcasting and the newspapers are hailing the event with great enthusiasm. Public opinion is that wireless telephony has come to stay and in years to come will play a role too large to be gauged in the light of past achievements.

RECORD LOG FOR ONE EVENING ?

Four American amateurs of the Sixth (Pacific Coast) district were "logged" by Mr. W. A. S. Batement, of N.W. London, on October 12th, with one, and occasionally two valves. These stations were **6 BKA, 6 BQR, 6 BJJ** and **6 ARB.** Seventy-nine other American amateurs were heard on the same evening.

GREEKS USE PRIVATE WIRELESS.

Wireless telephony has been seized upon as a valuable aid by a number of business houses in Greece, where the wireless regulations permit of the private use of this means of communication. Four important firms are already equipping their premises with the Marconi "Popular" wireless telephone set (type XP), to link up their head offices in Athens with their branch offices in the Piræus, and further enquiries for similar sets have been received from other commercial firms. This type of wireless telephone set has been designed for use by people possessing no technical knowledge, and is as easy to operate as the ordinary Post Office telephone.

GENEVA AS EXHIBITION CENTRE.

It is proposed that an International Wireless Exposition should be held in Geneva during September, 1925. The Exposition, which will occupy the Electoral Palace, will be designed to attract exhibitors and visitors from every corner of the globe.

COPYRIGHT TROUBLES IN FRANCE.

French broadcasting is threatened with trouble in the near future, in connection with the Copyright Law as it affects the playwrights, authors and music composers, who are claiming that the broadcasting stations are infringing copyrights wholesale.

It appears that when the matter comes before the Courts the broadcasting interests will have to contend with the three associations representing their opponents.

RADIO CONTROL IDEALS.

The successful voyage of the Zeppelin Z R 3 to America has prompted some remarkable assertions by the Italian inventor, Signor Fiamma, whose radio control device has recently roused great interest.

In an interview with a *Daily Telegraph* correspondent, Signor Fiamma said that he could have guided the ZR 3 to America from any part of the world at any distance, and could, with equal ease, have brought the airship back without a human being on board. The inventor added that with his apparatus it will soon be possible also to establish cross-channel air transportation at all times and in any kind of weather without any person on

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board. The aeroplanes would be directed simply by someone in a London office.

Similarly, affirms Signor Fiamma, covered-in, stormproof ships could be conducted across the seas, carrying goods to Calais, Boulogne, Ostend or any Continental port.

"MYSTERIOUS" BROADCAST PREACHER.

Reference was made in a recent issue to an unknown station broadcasting religious addresses at a late hour on Sunday evenings. A reader in the Bristol district replies to our query with the information that a religious service is broadcast between 10 and 11 p.m. on Sundays by Mr. Appleton, manager of the Cardiff station.

A CLUB MAGAZINE.

Other radio societies anxious to preserve enthusiasm among their members would do well to follow the example of the Woolwich Radio Society, who now produce a monthly magazine, "The Oscillograph."

From a perusal of the October number, a copy of which has reached our hands, it is evident that the personal note is well to the fore in the affairs of the Society. Among other features, "The Oscillograph" contains useful hints on transatlantic reception, notes of activities during the coming month and some delightfully informal reports of recent events. That inevitable section, "Things we should like to know," also finds a place. The cost of producing the magazine should not be high, as it is "Roneod."

FRENCH SCIENTIST ON SHORT WAVES.

M. Marius Latour, the famous French wireless engineer, expressed some interesting opinions on the subject of short waves in the course of a recent interview with our Paris correspondent.

M. Latour holds that, in spite of the experiments now being conducted on the lower wavelengths, the higher wavelengths of 1600 metres and above will always be extensively used. These waves at present possess a great advantage in that they are more stable in reception than those below 900 metres; moreover it is difficult to predict that successful and reliable daylight transmissions on short wavelengths will be ultimately achieved.

Asked whether he regarded satisfactory two-way Transatlantic broadcasting as possible, M. Latour stated that such a project was not only possible but probable. He doubted, however, whether American programmes would suit European tastes and *vice versa*.

PUBLIC ADDRESS SYSTEM.

Messrs. Autoveyors, Ltd., of 84 Victoria Street, London, S.W.1, inform us that they have been appointed Distributing Agents for the well-known Western Electric Public Address System.

The use of loud speaking apparatus for political speeches has gained increased favour during the present Election. The candidate in the above photo is seen using a microphone part of the Marconiphone equipment, suspended round his neck.

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THE TRANSMISSION OF PICTURES BY WIRE AND WIRELESS.

AN interesting paper on this subject was read by Mr. Thorne Baker, F.R.P.S., on October 17th, at the Royal Photographic Society's Headquarters, 35 Russell Square.

The lecturer is, of course, a well-known worker in this field of research and his remarks were illustrated by a series of lantern slides. He explained the several systems of photo-telegraphy which have been tried, and described the pioneer work of Korn and Bellini and his own researches.

It often happens in research work that methods which had been dropped are again revived in the light of some new discovery having an important bearing on it, and so it is with "photo-telegraphy."

The most successful system to-day is a development of that previously used by Korn, the principle of which may be understood by reference to Fig. 1. The picture which is to be transmitted is in the form of a transparency printed on celluloid and fixed around the glass cylinder G. This is rotated and a spot of light is caused to pass through the film and act on a selenium cell A. The intensity of the light acting on this cell, and consequently the resistance of the cell will, of course, depend upon the thickness of the deposit on the film and consequently the current in the output circuit will vary in sympathy. At the receiver the current passes through a special galvanometer and according to its strength will open a shutter to a varying extent, thus allowing a spot of light to fall on a sheet of photographic paper attached to a cylinder which is rotating at the same speed as the one at the transmitter.

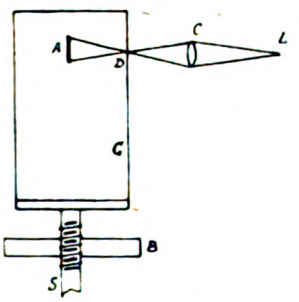

Fig. 1. The arrangement employed by Korn in early experiments.

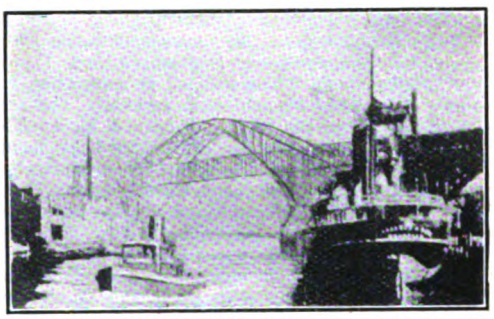

Fig. 2. A picture transmitted over a considerable distance

Elaborate arrangements are, of course, necessary to keep the speeds of these two cylinders exactly the same. The apparatus of to-day employs a photoelectric cell in place of the selenium, the latter having certain disadvantages, in particular that of lag.

The lecturer emphasised the difficulties experienced in actual working over long lines as against laboratory tests. In the latter case good results were certain, whereas the capacity of a long line often made faithful transmission almost impossible. From this point of view, therefore, the lecturer looks to radio as being capable of giving much more stable results, and a simple diagram of an early transmitter and receiver used by him was shown in a lantern slide.

Work is still progressing and the sensitive apparatus and stable form of transmitters now available leads Mr. Thorne Baker to predict that in perhaps a comparatively short time pictures transmitted by telegraph will be a regular feature in the pictorial newspaper world.

That this work has already reached a high standard is shown by the picture Fig. 2 reproduced here, which was transmitted over a considerable distance in America.

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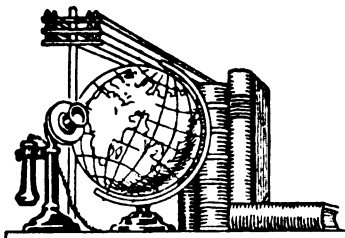

CORRESPONDENCE.

Transmitting Licences.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Referring to the correspondence on the above in your issue of September 3rd, I am of the opinion that "Newcastle" is somewhat hurt, but I should like him to think seriously, and try to place himself in the position of the P.M.G. and his staff, and to consider the difficulties they have to meet when application is made for a transmitting licence. Twelve months ago I applied for a licence, and in the end one was issued for the use of artificial aerial; to this I appealed but with no avail.

Now I really felt as much hurt as "Newcastle" does, but after twelve months with artificial aerial work I am now *certain* that the P.M.G. did me a good turn, for under such a condition one does much finer work than when permission for open aerial work is given in the first place. If I had to illustrate the work undertaken with artificial aerial, it would take up a great deal of space. And I think this is the best way one can really obtain perfection in transmitting apparatus when fitting up from components. Twelve months later I again appealed to the P.M.G. and after I had pointed out my experiments and progress, the necessary permission was granted to me.

In my opinion there is nothing unreasonable about this procedure, and before "Newcastle" can condemn anything that he hears on the receiver he should pay a visit to the transmitting end and see what is going on there.

And when he refers to qualifications, he may be interested in my record.

I have been lecturing and demonstrating X-rays, high frequency, including wireless, for a number of years, and have over half a ton of electrical and wireless apparatus to experiment with, three parts of which is of my own manufacture; half of this again is not even built from the bought components, but is constructed from the rough material

JOSEPH NODEN (6 TW).

Nr. Nantwich.

A Word for Transmitters.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—You publish a letter from John P. Wilson, of this town, in your issue of September 17th.

Mr. Wilson seems to have a grievance against local transmitters.

If your correspondent will cast his mind back to two years ago when there was no official broadcasting he will remember that amateur transmissions were a source of great benefit and incidentally brought into being the nucleus of the present listening-in public.

It is agreed that (based on present-day broadcasting) the amateur transmissions of these days were poor stuff, but half a loaf is better than no bread. It may interest Mr. Wilson to know that the present excellence of apparatus for short wave reception was mainly developed by experience gained from listening to these amateur(ish) transmissions, and local transmissions were thankfully received.

I think that your correspondent will find, if he listens in between the time stated, that the old hands, who at one time bore the brunt of the transmissions, are not now heard between the wavelengths of 300 and 500, but he will probably find them between 50 and 150, where they do no harm to anyone but themselves.

How does your correspondent know that the transmitters of whom he complains do not possess accurate measuring instruments? All the *licensed* transmitters whom I know have very good instruments and *do* carry out genuine experiments. I am afraid your correspondent is confusing the pirate who, under a wrongly granted or poached call sign, makes the ether hideous, Sunday after Sunday. Why should a man with a non-radiating licence have a call sign?

LOUIS J. WOOD,
(Hon. Sec., Halifax Wireless Club).

U.S. on 10-ft. Aerial.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In the early hours of Sunday, October 12th, with a three-valve receiver (2—v—0), and using a 10-ft. piece of wire hung across the room on a second-floor London flat, the writers heard the speeches made at a banquet given by the H. J. Heinz Co., of U.S.A., and broadcast by KDKA, Pittsburg.

The speeches lasted for over an hour and at 2.26 a.m. the chairman was heard, with a rap on the table, asking for order. He announced that President Coolidge would speak to the guests over the telephone from the White House, 400 miles away. Every word of the President's speech, which lasted for 20 minutes, was distinctly heard.

Later the chairman announced that he had just received a telegram from a "listener-in" that the speeches were being heard as if they were taking place in the room.

The conversation of the guests between the speeches was plainly heard.

THEODORE BRUMBY,
WILLIAM NICHOLSON,
(Members of the Hampstead and St. Pancras Radio Society).

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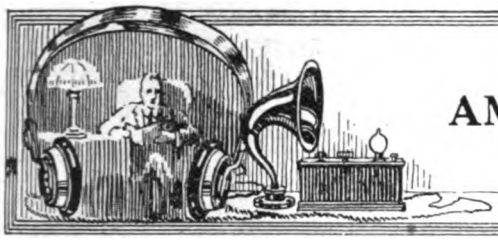

AMONG THE SOCIETIES.

Radio Society of Great Britain.

At the meeting of the Society held on Wednesday, October 22nd, the President, Dr. W. H. Eccles, F.R.S., moved, and Admiral Sir Henry Jackson, G.C.B., seconded, the following motion:

The Radio Society of Great Britain tender their congratulations to those members of the Society, namely, Mr. C. W. Goyder, Mr. Gerald Marcuse, Mr. E. J. Simmonds and Mr. J. A. Partridge, who have successfully established two-way radio communication with New Zealand, and they desire also to convey their felicitations to the Radio Society of New Zealand and to those New Zealand amateurs who co-operated in the experiments.

In moving the resolution it was pointed out that the fact that these experiments had been carried out in the early morning, about 6 a.m., raised the question as to which direction had been taken by the radio signals. The shortest route is an easterly one, by which the waves would travel over parts of Europe, Asia and India, but in the early hours of the morning in this country that route would be in full daylight and therefore probably a difficult one for the waves. The alternative route, which would be mostly in darkness, is via Greenland, the United States and right across the Pacific Ocean. This is a much longer route and it is also one which is mainly over water.

In either case the success of these experiments should point out the way for further research on this interesting scientific phenomenon.

* * * *

The unstinted admiration of all amateurs for the performance of the first four to communicate with New Zealand was well expressed in the following telegram addressed to Mr. J. A. Partridge:—

"Congratulations of Manchester transmitters on London gang's wonderful achievement."

A VISIT TO THE N.P.L.

A party of about 80 members of affiliated societies in the Eastern Metropolitan group paid a highly interesting visit to the National Physical Laboratory, Teddington, on Saturday afternoon, October 18th. The party, which arrived in two detachments, was conducted over the wireless section by Dr. Smith-Rose and Mr. Colebrook, who explained everything with great care and lucidity.

After the aerial and counterpoise system had been inspected, the apparatus in the transmitting shed was examined, and special interest was shown in the means of maintaining the wavelength absolutely constant by means of a master oscillator. The apparatus in the receiving hut was next visited, and the refinements employed to ensure absolute accuracy of measurement of signal strength and distortion proved a revelation to the amateur who is content to get his results accurate to 1 or 2 per cent. Several members wished they had brought their wavemeters along to be calibrated! The thanks of the group are due to Dr. Smith-Rose and Mr. Colebrook, and to all the officials who made the visit such a success.

* * * *

One of the chief difficulties of the Birmingham Wireless Club during the past year has been the lack of library accommodation. This has now been found, together with facilities for storing the club apparatus.

Many interesting fixtures have been arranged for the coming session, with as many demonstrations as possible.

* * * *

Considering that the modern valve is the outcome of the electric lamp, Mr. F. Bodenham's recent talk on "Electric Lamps," before the Radio Experimental Association of Nottingham, proved of extreme interest. The speaker described the early experiments of manufacturers with filaments of platinum, carbon and tungsten. Modern methods were also dealt with.

* * * *

Members of the Borough of Tynemouth Radio and Scientific Society turned out in full force to hear a recent debate on Broadcasting *v.* Experimenting.

Mr. Cowell spoke in praise of broadcasting as an aid to amateur experimenting, as it provided unique opportunities for testing. Mr. Byers contested that much of the best amateur work had been carried on independently of broadcasting. The meeting was unanimous in the opinion that broadcast listeners should join a wireless society and thus learn more about the fundamental principles of the science.

* * * *

The question of resistance capacity coupling formed the theme of discussion among members of the Battersea and District Radio Society on Thursday, October 9th, when an interesting lecture on the subject was given by Mr. A. E. Duffield, Chairman.

The Society is now starting actively on the winter session and applications for membership are invited.

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Many types of apparatus were on view at the October meeting of the Kensington Radio Society, including multivalve resistance capacity coupled receivers, coils for transmission and reception, buzzer and valve wavemeters. These had all been constructed by members and were intended for exhibition at the Paddington Technical Institute in connection with the Western Metropolitan Association of Affiliated Societies.

* * * *

"An International Language for Radio" formed the subject of a lecture delivered by Mr. George T. Smith before the Walthamstow Amateur Radio Society on October 16th.

The lecturer recounted how Esperanto had helped him in communicating with continental amateurs, by whom it was extensively used. After the lecture many members undertook to study Esperanto, and a resolution was passed expressing the Society's faith in this language as the best medium for international radio intercourse.

* * * *

A highly satisfactory year was reported at the annual general meeting of the Sale and District Radio Society, held on October 17th.

During the winter session, the Society's rooms will be open every evening. Arrangements are well in hand for the preparation of an attractive programme, and new members will be warmly welcomed.

* * * *

HIGH EFFICIENCY COILS.

In the article entitled "New Coils of High Efficiency," by Mr. J. H. Reeves, M.B.E., appearing in our issue of October 15th, the following additions or corrections should be made :—

Page 75, column 1, 2nd line under figure : for 3 16 read .036.

Page 75, column 1, 9th line under figure : for "cut-out" read "mark."

Page 75, column 2, 5th line from top : for "mark" read "drill."

Page 75, column 2, bottom : add "clamp tightly together."

Page 76, column 1, 3rd line from top : for "upper" read "lower."

Page 76, column 2 : add "unskilled workers should drill first all bars with a 6 B.A., and assemble with use of wood screws. The edge carrying the wire is the *upper* edge of each bar, as seen in Fig. page 75, column 1."

Page 76, column 2, 5th line from bottom : for "strengthening" read "straightening."

Page 77, column 1, 4th line from bottom : for "the best known makes" read "the best of mine."

FORTHCOMING EVENTS.

WEDNESDAY, OCTOBER 29th.

Tottenham Wireless Society. "Elementary Talks on Magnetism and Electricity, I."

Bristol and District Radio Society. "Wireless Lecture No. 1," by Mr. W. A. Andrews, B.Sc.

Clapham Park Wireless and Scientific Society. At 7.45 p.m. At 67 Balham High Road. Lecture : "Ebonite." By a representative of the British Ebonite Co.

Radio Research Society, Peckham. At 44 Talfourd Road. Lectures : "X Rays" and "Principle of the Multiple Tuner."

THURSDAY, OCTOBER 30th.

Bournemouth and District Radio and Electrical Society. At 7 p.m. At the Y.M.C.A., St. Peter's Road. Lecture : "The Microphone and Its Uses" (with demonstration). By Mr. J. Skinderviken.

Derby Wireless Club. Lecture by Mr. E. V. R. Martin.

Walthamstow Amateur Radio Society. General Discussion.

Hounslow and District Wireless Society. Lecture : "The Scientific Future." By Prof. A. M. Low.

Luton Wireless Society. At 8 p.m. At Hitchin Road Boy's School. Discussion of Difficulties.

West London Wireless and Experimental Association. At Belmont Road Schools. Question Night.

FRIDAY, OCTOBER 31st.

Bristol and District Radio Society. Demonstration and Address by Radio Instruments, Ltd.

MONDAY, NOVEMBER 3rd.

Hackney and District Radio Society. Vest Pocket Lectures.

TUESDAY, NOVEMBER 4th.

Manchester and District Radio Transmitters' Society. At 7.30 p.m. At the Grand Hotel, Aytoun Street, Manchester. Second Presidential Address, by Dr. L. S. Palmer.

Manchester Radio Scientific Society
DEMONSTRATION WORKSHOP.
WRIGHT & PALMER
ALL MACHINES and TOOLS USED ON THIS STAND
ROBERT KELLY & SONS LTD

A view of the Manchester Radio Scientific Society's stand at the recent wireless exhibition in that city.

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READERS PROBLEMS

Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

Valves for Reflex Receivers.

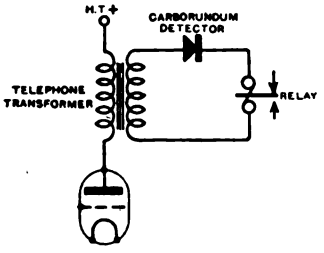
WITH the production of new types of valves, some with low impedance and others with high amplification factors, it is natural to ask whether any of these new types may be used with advantage in dual amplification receivers.

In our opinion it would be best to employ valves designed for general reception. Valves of this type generally have an average value of amplification factor and a moderately high impedance, and are therefore likely to give better results when called upon to amplify signals at both high and low frequency.

Recording of Morse Signals.

WE have recently received many enquiries from readers who wish to record Morse transmissions, either by means of a G.P.O. tape machine or the syphon recorder, and who would like to know the best method of connecting the recorder to their existing receivers.

The connections of one of the most reliable and simple methods are given below. The method consists in rectifying the alternating current output from the secondary winding of a telephone transformer connected in the plate circuit of the last valve, by means of a carborundum steel detector. A suitable relay is connected in series with the transformer secondary winding and the crystal detector,



and the current operating the recording instrument is controlled by the moving tongue and contacts of the relay in the usual way. To prevent sparking at the contacts, a non-inductive resistance of suitable value should be connected between the tongue and the "marking" contact. A relay of the G.P.O. or Siemen's type is very suitable for this purpose, and for comparatively slow speeds a Weston moving coil relay may be employed.

The object of using a telephone transformer with a high step-down ratio is to obtain as large a current as possible in the relay circuit. With the same object in view, a very small fragment of carborundum crystal should be used for the detector, in order that the resistance of the relay circuit may be kept as low as possible. By choosing the crystals with care, it will be possible to obtain a rectified current of at least 1 milliampere under favourable conditions. This current is more than sufficient for the operation of the relays mentioned above.

The Effect of Filament Temperature on Signal Strength.

A READER sends an account of some experiments which he has been carrying out with a receiver, the results of which seem to form an exception to the laws of the emission of electrons from valve filaments.

To explain the nature of the experiments, we cannot do better than quote from his original letter: "When the secondary cell supplying the filament current becomes discharged, the cutting out of the filament resistance temporarily restores signal strength, but there comes a point at which, although the filament is at normal brightness, and therefore normal temperature, the signal strength falls away. On connecting a newly charged accumulator, normal signal strength is obtained when the valve filaments are duller, and therefore much lower in temperature than was obtained using the nearly discharged cell."

The point which our correspondent wishes to make is that for a given filament temperature the results obtained from the set depend upon whether the battery is in a fully charged or partially discharged condition. Before questioning the validity of Richardson's formula for the emission of electrons from incandescent bodies, he should have made quite sure that all other conditions in the circuit were the same for both tests. As a matter of fact, the amount of external resistance connected in series with the filament was greater in the case of the fully charged battery, and the value of the grid bias applied to the valve is therefore much higher. When the battery was discharged, and the whole of the filament resistance cut out of circuit, the grid bias would be the same as the side of the filament to which the grid return lead was connected. The difference in the grid bias could easily account for the difference in the signal strength obtained.

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A RELIABLE THREE-VALVE RECEIVER.

A DIAGRAM is given below of a three-valve receiver suitable for reception of British and Continental broadcasting. With a good outdoor aerial it should be possible to receive all the B.B.C. stations and most of the Continental stations at telephone strength, while it should be capable of operating a small loud speaker at distances up to 50 miles from a main B.B.C. station.

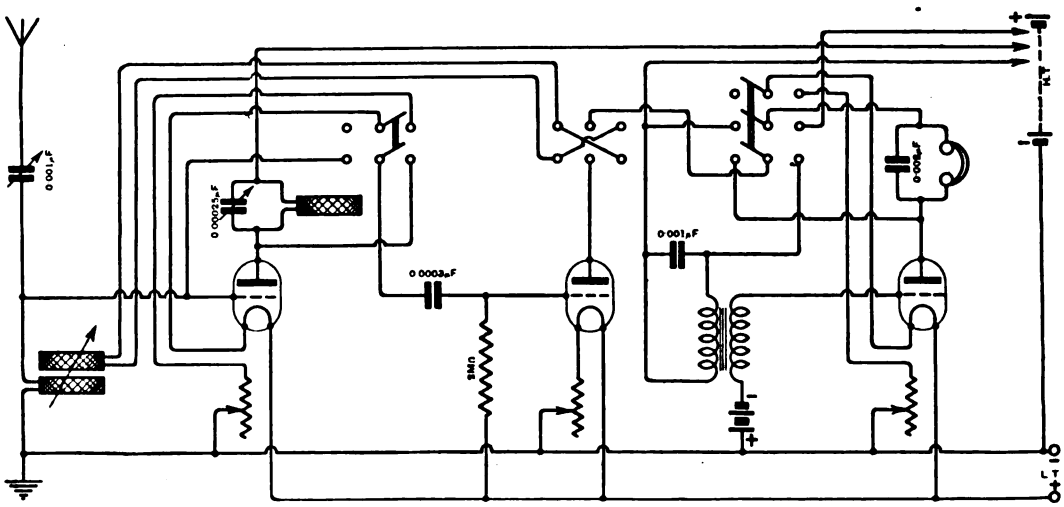
In order that the selectivity may be kept as high as possible, the aerial tuning condenser is connected permanently in series with the aerial circuit. With this arrangement there will be no difficulty in tuning on the band of wavelengths between 300 and 500 metres; but on the longer wavelengths the operation of the set may be simplified if the condenser is connected in parallel with the A.T.I.

Sheet stalloy iron and stampings of special shapes can be obtained from Messrs. Joseph Sankey & Sons, Ltd., Bilston, Staffs. Messrs. Sankey have two London offices: one at 168 Regent Street, W.1, and the other at 118 Cannon Street, E.C.4.

AN EASILY BUILT TWO-VALVE RECEIVER.

REFERRING to the article under the above title, in the issue of September 3rd, 1924, a reader asks where the 0·0005 μF condenser shown at the left-hand side of Fig. 4 is mounted in the actual instrument.

This condenser is fixed to the under side of the valve panel, immediately below the 0·0003 μF. grid condenser. The same screws are used to secure both condensers.



A reliable three-valve receiver.

From the point of view of signal strength and selectivity, it would be advisable to leave the A.T.C. in series for longer wavelengths. When using the series condenser on long wavelengths, the aerial coil will have to be chosen with greater care, as the variation of wavelength given by the condenser is not so great.

Separate H.T. tappings have been provided for the valves, each of which functions under different conditions. The modern tendency is to employ valves specially designed for the uses to which they will be put, and separate H.T. tappings are being used to a greater extent. With this arrangement a three-pole change-over switch is necessary for the L.F. valve, in order that the detector valve may receive the correct H.T. voltage under all conditions.

TRANSFORMER CORE STAMPINGS.

MANY experimenters who are building their own small power transformers have enquired where special silicon iron stampings to build the core may be obtained.

VALVES FOR A POWER AMPLIFIER.

A READER asks if D.E.4 type valves could be substituted for D.E.5 valves in the power amplifier described on page 210 of the issue of May 21st, 1924, and if any alteration in the values of components will be necessary.

As the resistance of the D.E.4 valve filament is approximately half that of the D.E.5, filament rheostats also of lower resistance may be used. An alteration in the value of the grid bias will also be necessary. With an anode potential of 120 volts and a grid bias of 5 volts, the anode current is 4·5 milliamps in the case of the D.E.4 valve. The total anode current will therefore be 9 milliamps, and a grid resistance of 550 ohms will be required to give a negative bias of 5 volts. If the same H.T. voltage is used for both valves, both grid return leads may be connected to — H.T.

The power that the D.E.4 valve is capable of handling is slightly less than that of the D.E.5, but will be quite sufficient to operate a large loud speaker of standard type without producing distortion.

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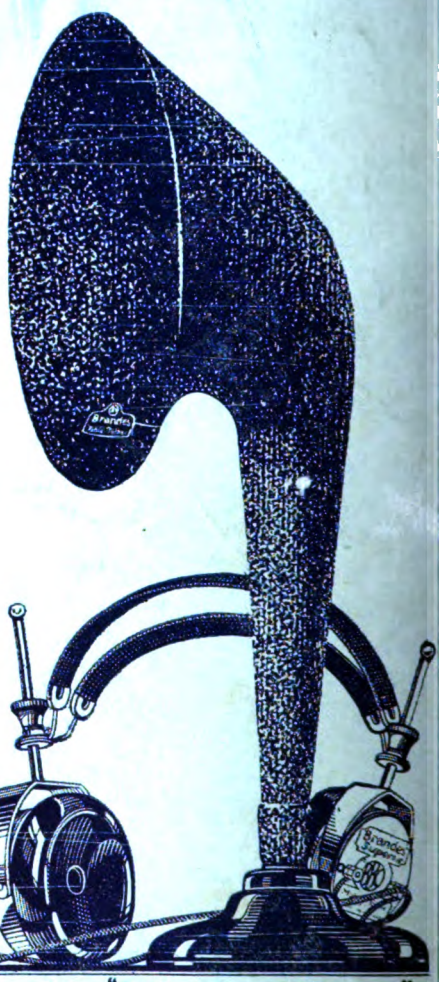

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THE WIRELESS WORLD AND RADIO REVIEW

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THE STORY OF AMATEUR COMMUNICATION WITH NEW ZEALAND

HETERODYNE WAVEMETER FOR 60—250 METRES

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

THE NEW ZEALAND SUCCESSES.

DUE to co-operation in true amateur spirit, we are able to publish in this issue first-hand accounts of communications with New Zealand from several of the principal contributors to these successes. These stories will, we feel sure, be read with the utmost interest and must act as a stimulus to further enterprise.

Mr. R. J. Orbell, the New Zealand amateur who owned the station **Z 3 AA**, has also contributed an account of amateur activities in New Zealand, and relates his experiences during his recent voyage to England *via* Cape Horn, when he operated an amateur station on short wavelengths throughout the voyage. On his arrival in England he was greeted with the news that direct amateur communication with New Zealand had been achieved, and, at the invitation of Mr. Goyder, of Mill Hill, he was able to take part himself in conversing by morse with his friends, from Mr. Goyder's station.

Apart from the successes which we recorded in our last issue, we have since received a number of additional reports of reception here of New Zealand stations, and also of reception there of British transmissions, whilst those who have effected two-way communication have repeated their results over continuous periods of as much as an hour and a-half.

Whilst recording these events we wish to draw attention to the fact that, apparently unwittingly, some amateur transmitting stations not taking part in these experiments have hampered communication with New Zealand by transmitting on wavelengths so very close to those employed for the New Zealand experiments that interference has resulted. It is hoped that, in view of the importance of these experiments, those transmitters who are likely to cause interference will hold off during the test hours unless they are themselves participating.

As far as long distance working is concerned it is difficult to see in what direction the British amateur can now turn in order to beat his own record. We wonder what the Americans will have to say about this achievement, which is the goal for which they have worked unfruitfully for many months past. However ready we should have been to congratulate others if this success had fallen to them, a very natural satisfaction is felt that British amateurs were the first to set up a world's record.

At the meeting of the Radio Society of Great Britain, held recently, Mr. R. H. Barfield gave a lecture on "Unsolved Problems of Wireless." In the discussion which followed, interest centred around these long-distance transmission results, and many speakers pointed out the importance of obtaining comparative quantitative results on the strength of signals at great distances on different points of the globe, for it was only from the collection of such data as this, which the amateur is in the best position to provide, that any new light can be thrown on the problems connected with the propagation of wireless waves round the earth.

No doubt the Radio Society of Great Britain will take all possible steps to collect and record data already obtained, and any new information which may result from further tests. Unfortunately it too frequently happens that valuable scientific data is lost or recorded so unsystematically that it is of little value as evidence when required.

THE EDITOR.

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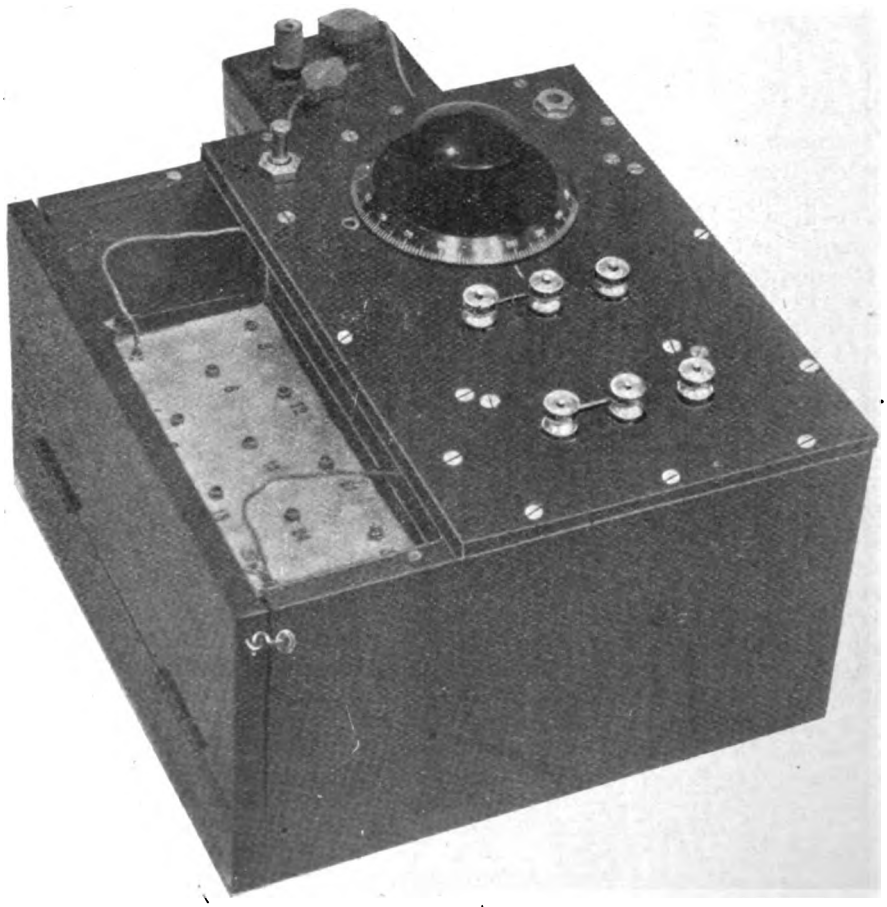
THE CONSTRUCTION OF A HETERODYNE WAVEMETER 60 TO 250 METRES.

By W. JAMES.

Introduction.

THIS heterodyne wavemeter was designed to meet the requirements of those amateurs who are interested in the reception or transmission of short wavelength signals. To be of value a wavemeter must be so designed that its characteristics do not change with use. Hence the coils must be well made from a mechanical as well as from an electrical point of view, in order that the turns shall not change their shape or their position on the formers, and be firmly secured in the instrument. Further, the variable condenser should be one having reasonably low losses, be rigidly constructed, and have a dial which is nicely engraved (in order that accurate readings may easily be taken) and which can be fixed securely to the shaft of the condenser. It is important to employ a well-made condenser, whose characteristics will not change with use.



A view of the completed instrument.

The wiring should be carefully carried out, with thick, rigid wires, well soldered at the connecting points and arranged so that wires cannot change their position.

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General.

The wavemeter is self-contained, and comprises a D.E.R. valve, a 2-volt accumulator (Exide, type DTG), two 15-volt dry cell units connected in series, a filament circuit (on and off) switch, a telephone jack (connected in the plate circuit), a variable condenser—maximum capacity 0·0005 microfarads (the one employed in this instrument is a Burndept standard condenser with screening case), a grid coil with one tapping, and a plate (reaction) coil with one tapping.

The illustration at the head of this article is a general view of the instrument. It will be seen that with the exception of the accumulator, everything is mounted inside the box. The accumulator rests on an extension of the base, and is situated here in order that it may readily be removed for charging.

The theoretical connections of the wavemeter appear as Fig. 1. It will be noticed that a tuned grid circuit is connected across the grid and filament of the valve. This circuit (mainly) fixes the wavelength of the oscillations which are generated.

No grid condenser and leak is employed. It was found that for the same applied filament and plate voltages the oscillations were much stronger when the grid return wire was connected direct to the negative side of the filament.

The capacity of the grid circuit is not, of course, localised in the tuning condenser. There is capacity between the elements of the valve, between connecting wires, and the coil has self-capacity. These stray capacities are in parallel with the tuning condenser. In addition, there is capacity between the grid and plate circuit coils. It is these capacities, added to the capacity of the tuning condenser (when set in the position of minimum capacity), which, for a given coil, decide the lowest wavelength of the oscillations which may be generated. Hence they should be reduced so far as possible.

The coil connected in the plate circuit is the reaction coil, and is in series with the plate battery and the telephone jack. Normally, that is, when the telephone plug is not in the jack, the plate circuit is closed through the long and short springs of the jack. When the telephone plug is inserted in the jack, the telephones are in series with the plate battery. High resistance telephones would normally be employed. A fixed condenser, capacity 0·002 microfarad, is connected between the positive terminal of the plate battery and the negative side of the filament to provide a low impedance path for the oscillating currents.

The grid and plate coils are tapped, and the tappings are taken to the terminals mounted on the face of the instrument. Copper links or wires are employed to connect the appropriate terminals, according to the wavelength range required.

It might be thought that it would have been better had a variable condenser of the "square-law" type been used. The condenser actually employed was chosen because of its good electrical and mechanical properties. The moving plates of this condenser are connected to the metal end plates,

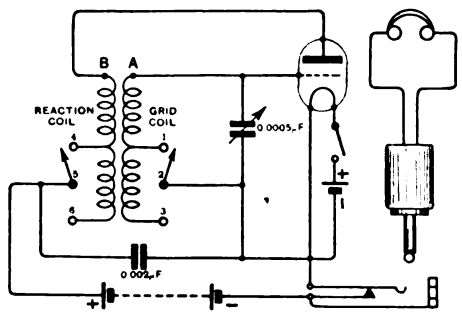

Fig. 1. Theoretical connections of the heterodyne wavemeter.

and the design is such that no flexible connection between the moving plates and a terminal is required.

As no grid condenser and leak is employed, the current taken from the plate battery is larger when the instrument is oscillating than when it is not. A simple method of determining whether or not the instrument is oscillating is by listening to telephones when the grid terminal of the valve is touched. If a click is heard when the finger is placed on the grid terminal and when it is removed, oscillations are being generated. When experimenting to determine the best size and spacing for the coils, a milliammeter was connected in the plate circuit, and readings taken when the circuit was oscillating at different wavelengths. First, a large reaction coil closely coupled to the grid coil was tried. It was found that strong oscillations were generated when the condenser

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was set near its position of maximum capacity, but that as the wavelength was lowered, the strength of the oscillations fell off, and finally ceased. By gradually reducing the number of turns, a point was reached where the oscillations were strongest at the middle of the wavelength range, and only slightly less in strength at the minimum and maximum wavelengths.

effects were produced by the dead-ends, and concluded that as a multipoint dead-end switch is undesirable in a wavemeter, it would be better to employ the simple switching arrangements shown in the figures. As may be seen from the figures, the precaution was taken of separating slightly the plate and grid coils at the tapping point.

It is interesting to note that the wavelength

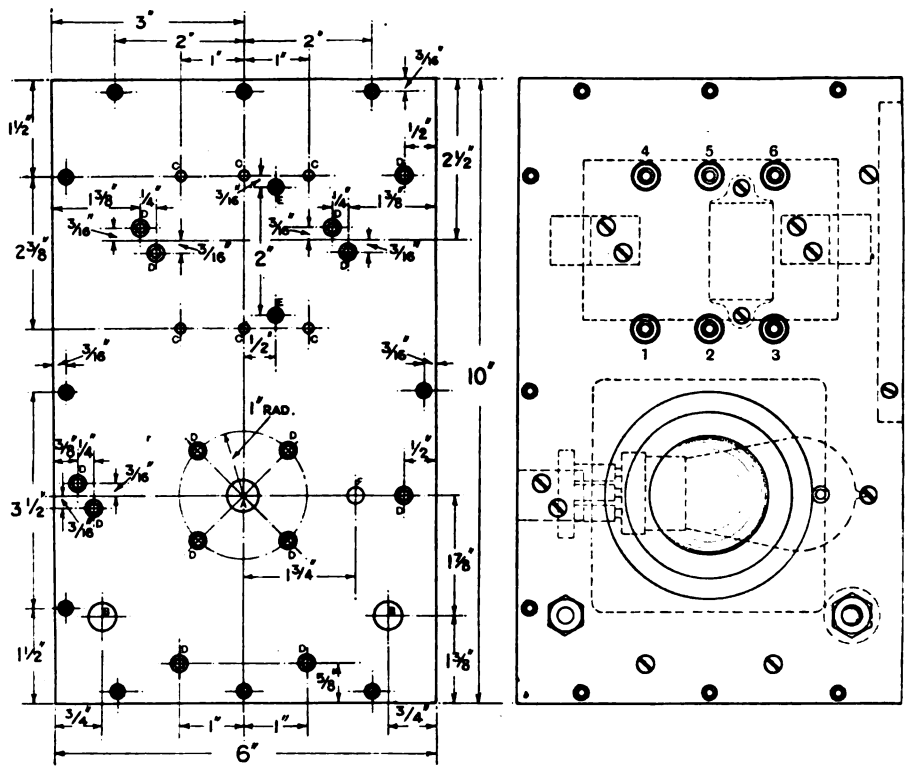

Fig. 2. The left-hand drawing gives the drilling details and the right-hand drawing the lay-out of the components. Drilling details, A, ¼" dia.; B, 7/16" dia.; C, 5/32" dia.; D, 5/32" dia. and countersunk on top side for No. 4 B.A. screws; E, ⅛" dia. and countersunk on topside for No. 6 B.A. screws; F, ¼" dia.

It was found essential to separate the grid and plate coils.

The plate coil which gave best results on the lower wavelength range was found not to give such good results as a larger coil on the higher wavelength range. Consequently a tapped plate coil was finally used. At first it was thought that the portions of the coils not in use when tuning over the lower wavelength band might give undesirable effects. The writer could not find that bad

ranges actually obtained are practically those predicted by simple calculations. Thus, the range of the condenser was assumed to be 0·0001 to 0·0005 microfarads, and the inductance between the end of the grid coil and the tapping 8·5 microhenries (No. 20 D.C.C., 7 turns per cm., 9 turns, former 2½ ins. diameter), giving a wavelength range of 55 to 123 metres. The actual wavelength range was from a little above 60 metres to 126 metres.

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Construction.

The wavemeter is contained in a box made of $\frac{3}{8}$ in. wood and measuring (outside) 10 in. by $8\frac{3}{8}$ in. by $5\frac{1}{2}$ ins. An ebonite panel 10 ins. by 6 ins. by $\frac{1}{4}$ in. carries the components, which are arranged as indicated in Figs. 2 and 5. The plate dry cell battery is situated in one end of the box, and the filament heating battery of one cell is carried on an extension of the bottom of the box. (Fig. 6.)

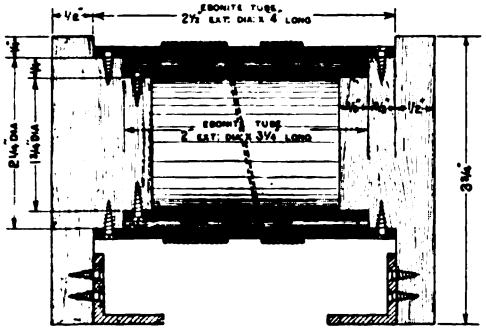

Fig. 3. A detailed drawing of the grid and reaction coils, and their supports.

The Coils.

The coil connected in the grid circuit is wound on a length of ebonite tube 4 ins. long, $2\frac{1}{2}$ ins. diameter and $\frac{1}{8}$ in. thick; the plate coil is wound on another tube which is $3\frac{1}{4}$ ins. long, 2 ins. diameter, and $\frac{1}{8}$ in. thick. As will be seen from the drawings and photograph, the plate coil is mounted inside the grid coil, and both coils are firmly held in position by means of two pieces of wood shaped to fit the ends of the coils. Details of these end pieces and the method of fixing the coils are given in Fig. 3. The end pieces are cut from a piece of wood about $\frac{7}{8}$ in. wide, and the projecting pieces rounded off to fit the inside of the tubes. Holes are provided in the ends of the tubes, and wood screws passed through them to secure the tubes to the end pieces.

Before winding the coils, provision is made for holding the end turns by drilling holes in the ends of the tubes, and No. 6 B.A. screws (to which are soldered the ends of the plate coil) are screwed in the outer tube. These details may be seen in Fig. 5.

Having constructed the former and supports, the coils may be wound. The coils are wound in opposite directions. Commencing with the grid (outer) coil, start $1\frac{1}{2}$ ins. from one end, and wind 9 turns of No. 20 D.C.C. with the turns touching. Then wind the 10th turn half an inch away from the 9th turn, and continue winding until a total of 23 turns are wound. Solder a wire to the 9th turn at the point where it lies about half way between the two portions of the winding. When looking at the end of the coil nearest the side of the box, this winding should run in an anti-clockwise direction. For the plate circuit coil wind in a clockwise direction, starting $1\frac{1}{2}$ in. from one end of the tube, wind on 15 turns of No. 30 D.C.C., with the turns touching. Then wind the 16th turn three quarters of an inch away from the 15th turn, and continue winding until a total of 35 turns are wound. A wire is soldered to the 15th turn of the plate coil, and this wire and the two ends are finally brought through holes in the outer former and soldered to the No. 6 B.A. screws secured therein. Finally, dry and varnish the coils.

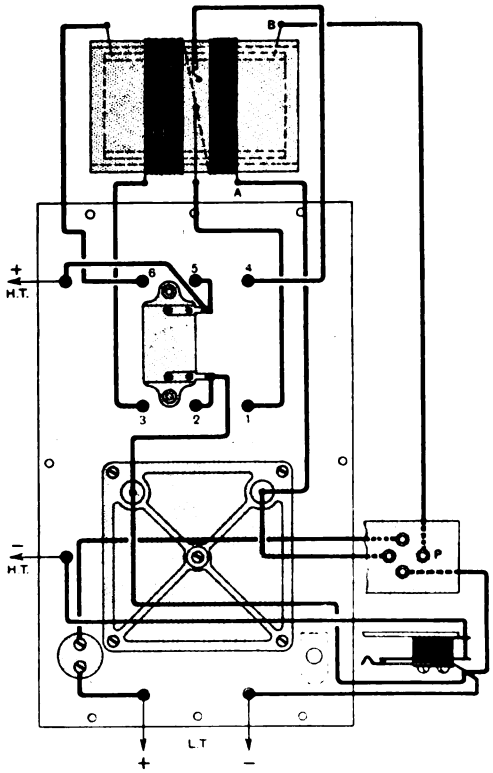

Fig. 4. The wiring diagram. The figures and letters correspond with those on the theoretical diagram.

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Referring for a moment to the theoretical circuit, Fig. 1, the grid coil contains 9 turns between the grid and the tapping, (A and 1), and the plate coil 15 turns between the plate and the tapping (B and 4).

The Valve Holder.

The valve holder consists of a piece of ebonite 4½ ins. by 1½ ins. by ¼ in., carrying four valve sockets at one end, and a brass bracket at the other, as shown in Figs. 2 and 5. The bracket is screwed to the panel, and the side of the box cut away to permit the panel to fit flush. The valve, when in position, lies in the space between the bottom of the box and the bottom of the variable condenser.

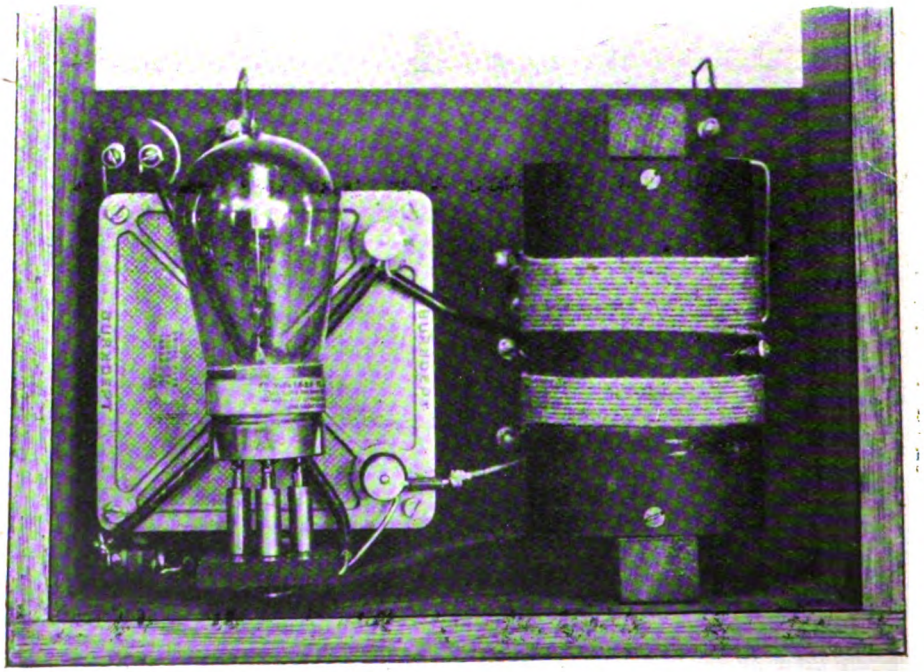

Fig. 5. A view of the wavemeter, looking at the underside with the bottom of the box removed.

Assembling and Wiring the Instrument.

Having constructed the coils and their supports and the valve holder, it is an easy matter to fit the terminals, the fixed condenser (0·002 μF), the jack, the switch, and the No. 4 B.A. screws which serve as connecting points for the batteries. The instrument is wired with No. 16 tinned copper wire, which is stretched and cut into suitable lengths. It will be observed from the figures that all the wires at low voltage are at one end of the instrument, and that the wires are provided with an insulating covering. It is an easy matter to wire the instrument from the wiring diagram of Fig. 4, but care must be taken to make each wire short and rigid. Flexible wires are connected to the terminal screws for the plate battery and the filament accumulator, the latter wires passing through holes in one side of the box. Special attention should be given to the wiring of the coils. As the windings are in opposite directions, the two ends (looking at one end of the coils) are connected to grid and plate respectively. If the coils were wound in the same direction, the two ends (from the same end of the coils) should go to grid and plate battery respectively.

To prevent the plate battery moving, a piece of ⅜-in. wood is screwed to the edge of the panel, as may be seen from the illustration on page 152.

Using the Wavemeter.

For low wavelengths, connect grid terminals 1 and 2, and plate terminals 4 and 5,

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and the plate and filament batteries. For higher wavelengths, grid terminals 2 and 3 and plate terminals 5 and 6 are connected. Calibrate the instrument in one of the well-known ways. The following figures, which are correct for the wavemeter illustrated here, show one what to expect.

Higher Range.		Lower Range.	
Wavelength Metres	Setting of Condenser	Wavelength Metres	Setting of Condenser
250	180	126	180
245	170	121·5	170
239	160	118	160
233	150	115	150
226	140	112	140
219	130	108	130
211	120	105	120
204	110	101	110
196	100	97	100
187·5	90	93	90
178	80	89	80
168	70	85·5	70
158	60	81·5	60
150	50	78	50
141	40	74	40
130·5	30	70	30
120	20	67	20
110	10	64	10
99	0	62	0

It is advisable after calibrating the instrument to draw curves on squared paper to show the relation between the setting of the variable condenser and the wavelength. The reader will find that the calibration is affected by changing the valve or the batteries—in fact the calibration changes slightly as the batteries run down. However, a few tests will show to what extent the calibration is affected by changes of this sort.

A heterodyne wavemeter may be used, of course, in many measurements, but it is principally employed to determine the wavelength of the energy radiated from a transmitter, or to calibrate a receiver.

To measure the wavelength of a transmitter, put the telephone plug in the jack and tune the instrument until a beat note is heard in the telephones. The beat note is set up by the oscillations of the wavemeter combining with the oscillations induced in the coils of the wavemeter from the transmitter. Then adjust for the "zero beat" or "silent point." The wavelength of the wavemeter is then the same as the wavelength of the transmitter. This method is not always satisfactory when the transmitter is rated at over about 10 watts. Amateurs will find that a fairly reliable reading may be taken by employing a low power lamp in the tuned circuit, or by connecting a neon tube across the circuit. The instrument should be calibrated with the lamp or neon tube in circuit.

To determine the wavelength of a distant transmitting station heard on a receiver, carefully tune the receiver by letting it oscillate and adjust it for the "silent point." Then tune the wavemeter (the telephone plug may be removed from the jack of the wavemeter) until a note is heard in the telephones attached to the receiver. Now carefully adjust the wavemeter for the "silent point" condition; the wavemeter is now set at the same wavelength as the distant transmitting station.

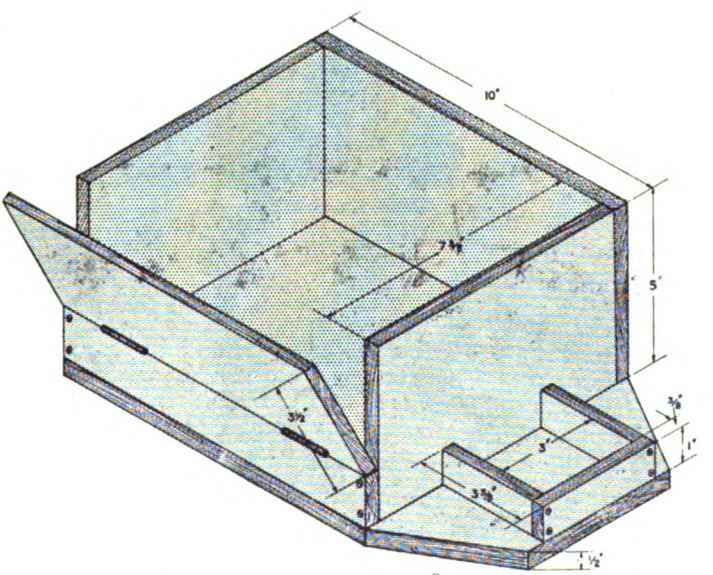

Fig. 6. The construction of the box

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A FRENCH WIRELESS PIONEER.

BANQUET IN HONOUR OF PROFESSOR BRANLY.

ON Thursday, November 6th, a banquet will be given in Paris in honour of one of the pioneers of wireless, M. Edouard Branly.

The principal invention associated with the name of Branly is his famous "coherer," which contributed in no small measure to the success of Senatore Marconi's earliest experiments in wireless telegraphy. At that time the coherer was, in fact, the only practical rectifying device, and several years elapsed before it yielded place to the more stable crystal detector. In 1899, the first wireless message was transmitted across the Channel. It was addressed to Professor Branly, and ran: "Signor Marconi sends his respectful compliments by wireless telegraph across the Channel, this admirable result being in part due to the remarkable work of M. Branly."

Professor Edouard Branly, the eminent French wireless engineer, who has just celebrated his eightieth birthday.

Educated at the St. Quentin and Henry IV. Colleges in Paris, M. Branly later became a Fellow of the University, a Doctor of Physical Science and Doctor of Medicine. His researches in wireless date back to about 1887, and in 1890 and 1891 he filed patents relating to the electrical conductivity of radio-conductors and to the operation of a local relay circuit from a distance.

It cannot be said that M. Branly's genius has been overlooked by his fellow countrymen. In 1900 the French Minister of Public Instruction created him an Officer of the Legion of Honour, and some years later the French Press was instrumental in raising a public subscription for his benefit. When, a few years ago, the French Chamber voted him a grant of £800 per annum, he modestly declined, preferring to rely upon his own limited means.

Of recent years Professor Branly has been devoting his attention to various independent distributing devices for producing tele-mechanical effects without wires. He is a tireless worker and, it is said, spends ten hours daily at his researches.

Professor Branly celebrated his 80th birthday on October 22nd, when he was the recipient of thousands of congratulations.

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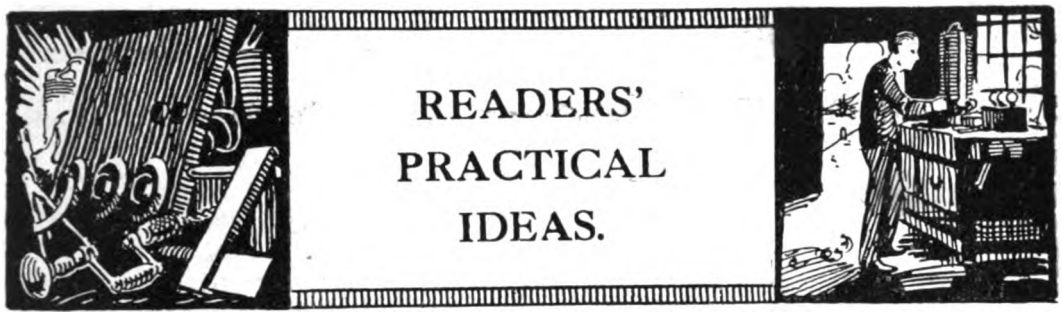
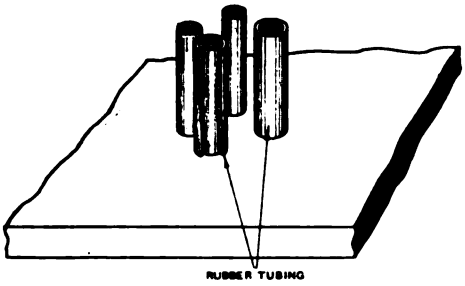


Protecting Valve Sockets.

THE type of valve holder which is built up from valve sockets is once more becoming popular, for experimenters are beginning to realise that this form of construction is simple and cheap, and what



Rubber tubing slipped over the sockets eliminates the risk of a burnt-out filament.

is more important, produces a holder of low capacity. There is a danger with this type of holder, however, of making contact between the filament legs of the valve and the high tension potential of the plate battery. Risk of thus burning out the filament can be entirely eliminated by slipping pieces of india-rubber tubing over the sockets.

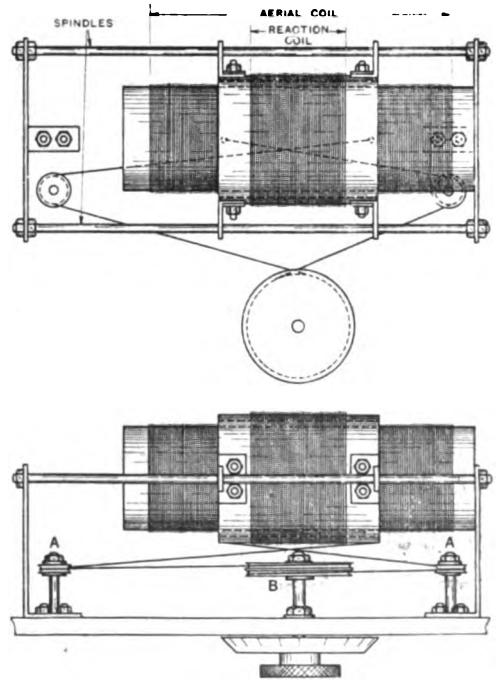
F. B.

A Novel Variable Coupling.

A THREE-COIL holder is probably the most generally used method of arranging for variable coupling between inductances, and its popularity is due to the convenience with which various sized coils can be readily interchanged.

When constructed, the coils are frequently of the single layer type, and a difficulty arises in devising a suitable method of variable coupling. To avoid employing a pivotted coil, a sliding inductance will be found to give quite critical coupling, and is very useful when one of the coils is used to produce reaction effects.

The accompanying illustration shows how the moving coil may be set up, and this form of construction has the advantage that operation is effected by means of a rotating knob and dial. The diagram shows that a pulley is secured to a rod by the knob and dial, and in the two grooves of this dial is



A novel method of effecting adjustable coupling between two coils.

B.

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wound a string which attaches to the moving coil. The string is actually tied to the pulley at one point so as to avoid slip. The two ends of the cord are terminated as shown, and the moving coil is set up to slide on two rods, which may be constructed from brass. If it is thought that the proximity of the metal rods to the winding gives rise to inefficiency the brass rods may be replaced by glass and secured at the ends by glueing into wooden supports.

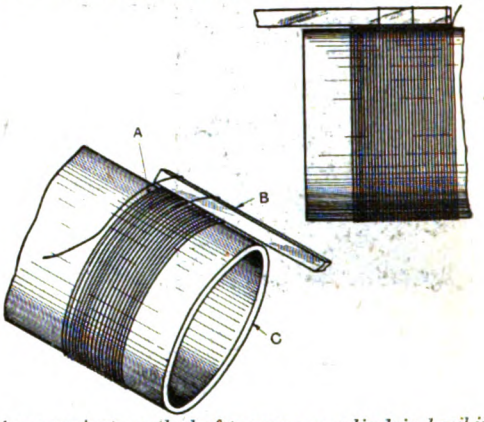
J. L. H.

On and Off Switch.

TO avoid the use of a number of switches for bringing the receiver into operation, the accompanying circuit shows a method by which all the necessary battery connections can be made by the movement of a single lever. It will be noticed that the arm of the switch closes circuits for grid cells, filament battery and high tension battery. When the set is not in use the lever connects the aerial to earth.

A. L. B.

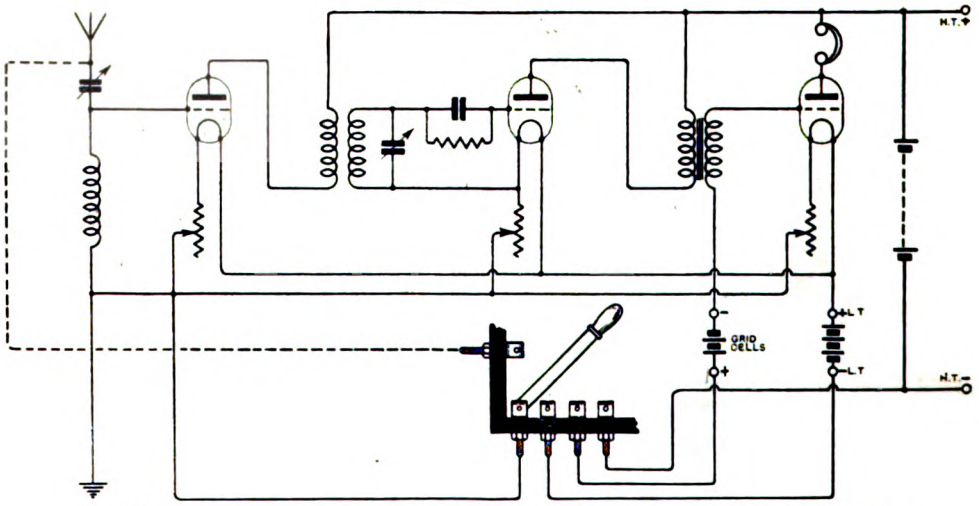
reached, when a strip of ebonite having a cross section of $\frac{1}{4}$ in. by $\frac{1}{4}$ in. is slipped under the wire and remains thus held until the



A convenient method of tapping a cylindrical coil in which an ebonite strip is used to raise the required windings.

next tapping point is required. It is then carefully slid along and serves to raise another turn out of contact with the former. This process is repeated till the end of the coil is reached. The outside edges of the ebonite which are in contact with the wire should be slightly rounded to prevent damage being done to the insulation. It is now quite easy to scrape the insulation from the wire and make a good soldered connection.

C. N. G.



A combined switching arrangement for disconnecting the batteries and earthing the aerial.

A Neat Tapped Coil.

THE tappings on a single layer coil can be made by a variety of methods, but probably the neatest arrangement is that shown in the accompanying illustration. The preliminary turns are wound on in the ordinary way until the first tapping point is

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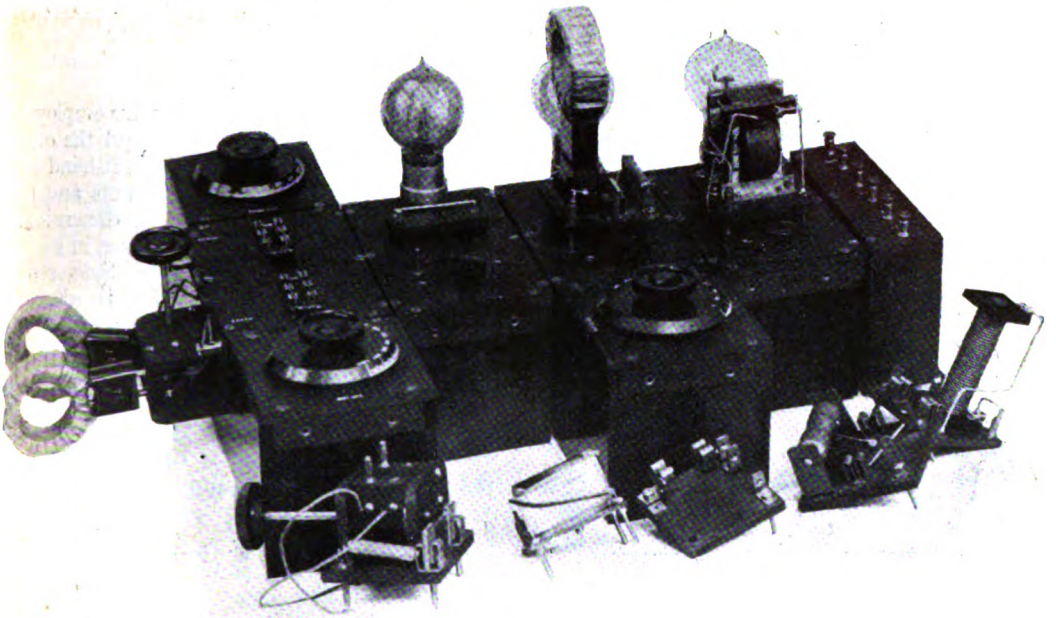

A THREE-VALVE UNIT RECEIVER.

In the first instalment of this article the author described the construction of the tuning and condenser units. He now describes the valve units, the terminal unit, and the coupling units.

By R. H. COOK.

(*Continued from page 126 of previous issue.*)

HAVING completed the tuning unit and the two condenser units, we may turn our attention to the amplifier and detector.

A number of three-valve circuits which may be tried with this receiver were given in the first portion of this article (page 124, October 29th issue). Fig. 6 gives a number of two-valve circuits. Fig. 6A shows the connections for two stages of high frequency amplification with transformer coupling and a crystal detector. Fig. 6B gives the connections with one stage of high frequency amplification, followed by a crystal detector and one note magnifier.

The next circuit, Fig. 6C, is that of a two-valve receiver having one stage of high frequency amplification with tuned anode coupling, valve detector, and with the reaction coil coupled to the anode coil. Fig. 6D gives the connections of a receiver comprising a crystal detector and two stages of low frequency amplification, and Fig. 6E a valve detector with note magnifier.

THE VALVE UNITS.

The valve units are similar in every respect. Those who wish to employ three valves will, of course, construct three units. Each unit has a top panel of ebonite 6 ins. × 4 ins. × ¼ in. carrying a valve holder, a filament resistance and the adaptor sockets and pin (Fig. 8). The valve holder consists of the usual sockets screwed to the ebonite panel. Three sockets and one pin are mounted to form the adaptor socket. This

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arrangement of sockets and pins is employed to prevent the possibility of inserting the adaptor in an incorrect position. A fourth socket is mounted just below the pin. The position of the parts is clearly shown in Fig. 9.

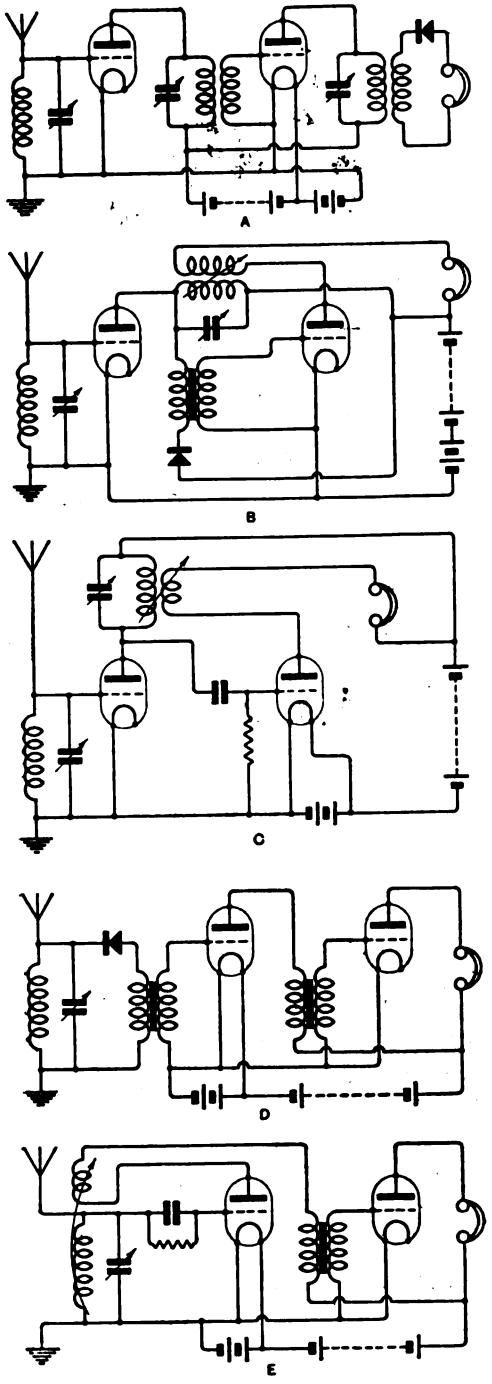

Fig. 6. Showing a number of methods of connecting two-valve receivers.

Three side connection strips are employed, one on each of the long sides and the other on the front of the panel. The left-hand and front strips are fitted with sockets and the right-hand strip with pins. A dimensional drawing of the side strips was given in Fig. 3, page 125, October 29th issue. Side strips carrying pins and sockets in this way are employed in place of the usual terminals. To connect units it is only necessary to place them side by side and to fit the pins in the sockets. The front sockets are for plugging in a condenser to tune the unit when it is employed as a tuned anode or a H.F. transformer coupling.

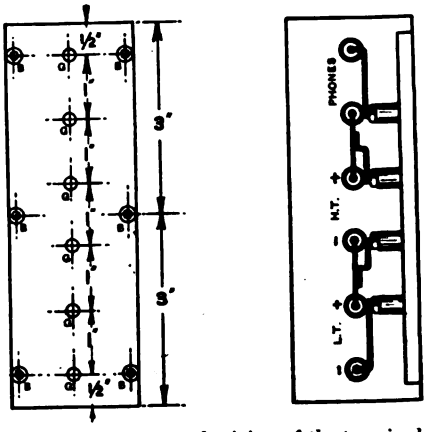

Fig. 7. Dimensions and wiring of the terminal unit. B, 5/32" and countersunk for No. 4 B.A. screws and wood screws; G, 5/32" dia.

The wiring of the panels is given in Fig. 8. It will be observed that the lower three pins and sockets are connected to the filament and plate circuits, the top left-hand socket to a socket of the adaptor and one of the sockets on the lower strip, and the top right-hand pin to the plate of the valve. The strips are secured to the panel by No. 4 B.A. countersunk screws; the centre screws seen in the drawings are wood screws which pass through the side strips and hold the panel and side strips to the box. The box is of course cut away on three sides to take the side strips.

THE CONDENSERS.

Those who construct three valve panels and propose to employ one or two stages of

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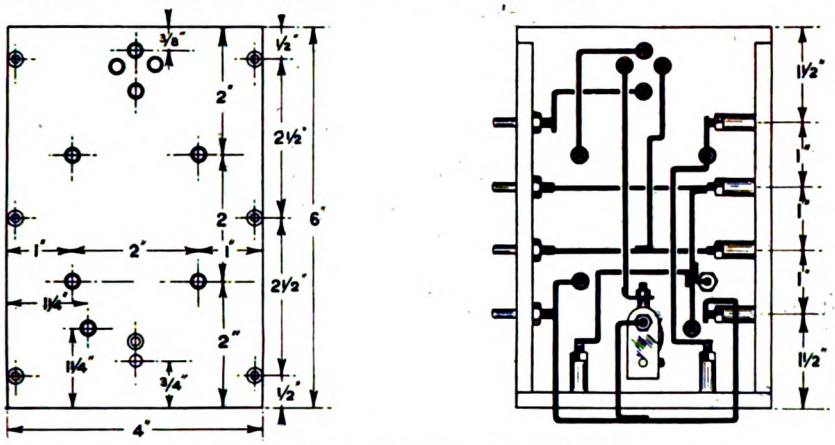

Fig. 8. Layout and wiring of a valve unit.

tuned high frequency amplification should also construct one or two condenser units respectively. The condenser units each consist of a box containing a 0·0002 μF. tuning condenser connected to two pins fixed on a strip carried at one end of the panel. These units are built up precisely as indicated in Figs. 4 and 5, page 126, October 29th issue.

THE TERMINAL UNIT.

This is a panel 6 ins. × 1½ ins. mounted on a box carrying six terminals for the various

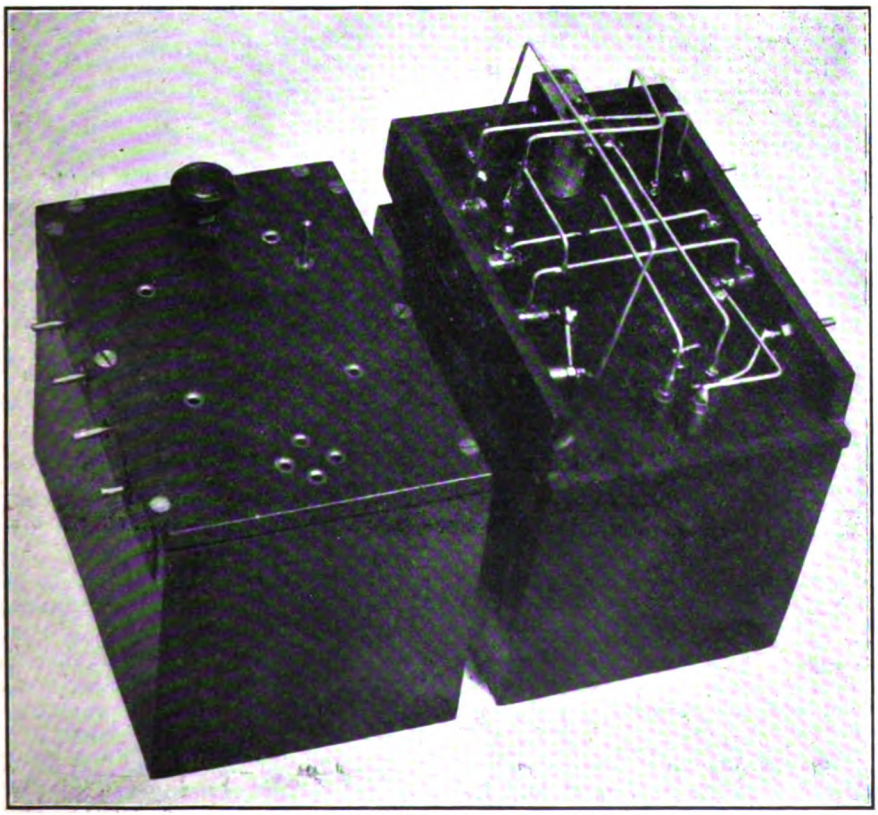

Fig. 9. Views of a valve unit.

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connections and a side strip with six sockets. The terminal panel can be plugged in the last valve panel. Details of the construction appear in Fig. 7.

THE COUPLING UNITS.

The coupling units each comprise a small ebonite platform carrying pins and a socket to fit the corresponding sockets and pins in the valve panel, and the components which are required for the coupling.

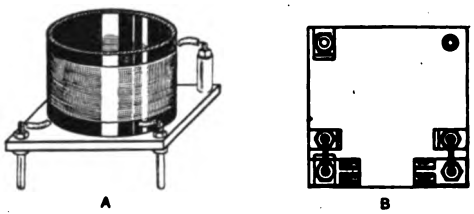

Fig. 10. (*A*) *A sketch of a high frequency transformer unit*; (*B*) *The arrangement of a resistance-capacity unit which consists of an anode resistance, grid condenser, and grid leak.*

Dealing with high frequency couplings first, we have in Fig. 10A details for the construction of a high frequency transformer unit and in Fig. 10B for the construction of a resistance capacity unit. The ebonite platform of the couplings is 3 ins. × 3 ins. × ¼ in., and the pins and socket are mounted at the corners of a 2 in. square to fit the corresponding sockets and pins provided on the panels. The high frequency transformer consists of two coils, wound on an ebonite tube and connected to the pins and sockets. Details of the winding will be given in the final instalment of this article. For the resistance-capacity coupling unit it is only

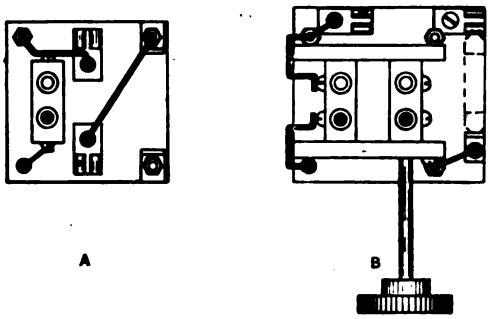

Fig. 11.
(*A*) *A tuned-anode unit.*
(*B*) *A tuned-anode and reaction, or transformer unit.*

necessary to provide clips for the anode resistance, the coupling condenser, and the grid leak.

The construction and connections for a unit which may be employed as a tuned

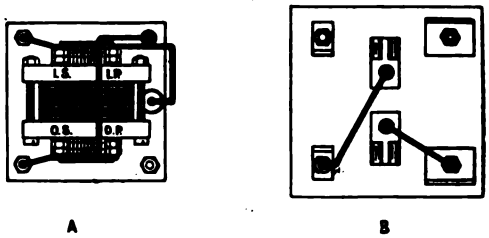

Fig. 12. (*A*) *A transformer unit*; (*B*) *A resistance-capacity unit.*

anode coupling are given in Fig. 11A and consists of a single coil mounting and clips for the fixed condenser and grid leak. A two-coil holder is mounted on the unit of Fig. 11B, with clips for a fixed condenser and grid leak. The fixed condensers referred to are the grid condensers normally employed with high frequency couplings and may have a capacity of 0·00025 mfds.

For the low frequency couplings, three units are provided—one for transformer

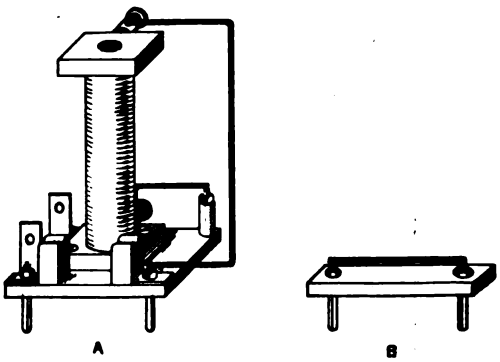

Fig. 13. (*A*) *A choke-capacity unit*; (*B*) *A short circuiting unit.*

coupling, one for resistance-capacity and the other for choke-capacity coupling. These units are sketched in Figs. 12A and B and Fig. 13A.

The resistance-capacity unit may have an anode resistance of 70,000—100,000 ohms, a coupling condenser of 0·05 μF., and a grid leak of 0·5 megohms. In the choke-capacity unit a grid leak and coupling condenser of 0·5 megohms and 0·05 μF respectively may be employed, with an iron-cored choke coil.

The unit shown in Fig. 13B consists of a strip of ebonite carrying two pins which are connected together.

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WIRELESS IN THE MIDLANDS.

SUCCESS OF THE MANCHESTER EXHIBITION.

MANCHESTER'S wireless exhibition, which was opened on October 14th, in the City Hall, Deansgate, by the Rt. Hon. Lord Colwyn, P.C., gave abundant proof of the enthusiasm with which the Manchester public have received wireless. Organised by the *Evening Chronicle*, the Exhibition exercised a wide appeal both popular and technical, and the fact that its doors remained open until the 25th of the month without any diminution in attendance, is proof that its aims were adequately realised.

To club members one of the principal features of the Exhibition was the grand rally of radio societies of the North of England on Saturday, October 18th, when an address was given by Dr. W. H. Eccles, F.R.S., President of the Radio Society of Great Britain. On other days, interesting lectures and demonstrations were provided by Mr. Philip R. Coursey, B.Sc., Research Editor of *The Wireless World and Radio Review*, Mr. F. H. Haynes, Assistant Editor of the same Journal, Mr. R. H. Wood, Engineer-in-Chief of **2 ZY**, and other well-known experts.

A corner of the City Hall, Manchester, during the recent wireless exhibition, which drew enthusiastic crowds for nearly a fortnight.

Ever since the inception of broadcasting, the *Manchester Evening Chronicle* has been among the foremost journals to foster public interest in the new art, and its regular contributions on the subject, together with constructional competitions, have found an increasing circle of readers and enthusiasts. As a promising experiment the Exhibition met with indubitable success, and its interest was considerably enhanced, not only by a number of entertaining lectures and demonstrations, but by many new and original exhibits.

A word must be said regarding the efficient technical organisation of the Exhibition, which was entrusted to the Manchester Radio Scientific Society. Excellent loud speaker demonstrations were carried out by the Society, whose labours in this direction were admirably supported by **2 ZY**, the Manchester Broadcasting Station, which transmitted appropriate instrumental music.

No fewer than 121 stands were occupied, both by local and "outside" firms, and in view of the immense variety of excellent material on show, it is difficult to single out any particular items for comment. Crystal and multi-valve sets were well represented, besides the increasingly popular loud speaker, but among novel and original items which deserve special mention must be included the interesting "Atlas" filament control exhibited by Messrs. H. Clarke & Co. (Manchester), Ltd. This makes use of piles of carbon pellets and provides for the most minute adjustment of filament temperature.

Another filament control device of interest was that shown by the City Accumulator Co., and illustrated on the next page. Designed by Mr. Alan L. M. Douglas, this filament resistance is specially intended for mounting on the face of a panel.

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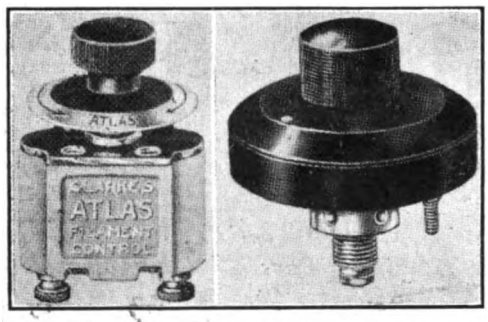
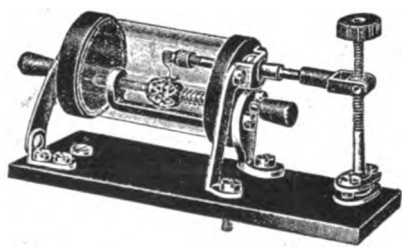
A full range of receivers manufactured by the Marconi Scientific Instrument Co., Ltd., was exhibited on the stand of Messrs. Halliwell & Good, Ltd., of Manchester, which appears in the foreground in the photo opposite.



Two interesting filament rheostats on view at the Manchester Exhibition.
Left: A device making use of carbon pellets.
Right: The City Accumulator Co's product.

A useful accessory exhibited was the "Star" dustproof crystal detector, illustrated on this page. Besides affording protection from dust, the detector is fitted with rotary action, giving an almost unlimited choice of sensitive spots.

One of the most ingenious devices on show was the "Liberty" Safety Wander Plug, manufactured by the Radiac Electrical Co., Ltd. The current passed by this plug is sufficient to supply the



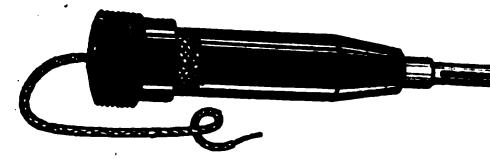
The "Star" dustproof crystal detector, with useful rotary control.

circuit, but insufficient to destroy the valve filament. The slogan of the manufacturers is, "Insure your valves for 2s. 6d." Another product of this company on view was the "Liberty" Tuner, embodying a novel form of variometer, the principle of which will be understood from accompanying illustration.

The problem of housing the newly-constructed set in a suitable cabinet is one that has confronted every amateur constructor at some time or another. A stand almost entirely devoted to wireless cabinets of all grades and sizes, was that of Messrs. Henry Joseph & Co., Ltd., whose products extended from cases for the smallest crystal sets to handsome cabinets for multi-valve receivers.

As might be expected, the stand of the Manchester Radio Scientific Society was of exceptional interest to amateurs and experimenters. Messrs. Harold Green and L. Lomas both exhibited transmitting gear, and in addition much curiosity was aroused by a combined wireless and gramophone set constructed by Mr. Kemp.

Other items of more than usual interest were a combined lead-in tube and earthing switch by Messrs. W. H. Murad & Co. and the Ericsson low capacity key switch for H.F. circuits (exhibited by Palatine Wireless Equipment Co.).

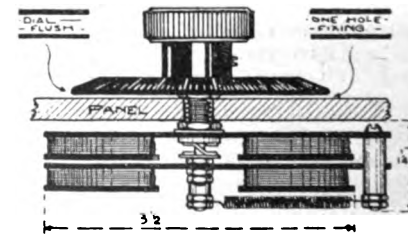


The "Liberty" Wander Plug, ensuring safety for filaments.

In addition great public interest was apparent in the realistic reproduction of a ship's cabin, equipped with a half-kilowatt quenched spark transmitter and standard Marconi receiving gear.

The outstanding impression gained by a London visitor to the Exhibition was the remarkably keen spirit which animates Manchester amateurs. The home constructor was in evidence everywhere, and it became increasingly apparent that with a natural aptitude for practical work the northern amateur combines a real appreciation of the value of theoretical knowledge, without which success can hardly be hoped for.

During the first four and a half days of the Exhibition 90,000 persons paid for admission.



A novel variometer produced by the Radiac Electrical Co., Ltd.

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THE STORY OF

THE NEW ZEALAND SUCCESSES

The setting up of a world's record in amateur communication, as reported in our previous issue, has aroused considerable interest, not only to transmitters, but among all those who followed the development of wireless telegraphy. We are fortunate in being able to give publication below to a detailed report of the work carried out, compiled by the operators in this country who have participated. In addition, Mr. R. J. Orbell, an active experimenter in New Zealand, who has just arrived in this country, gives some details of the stations with which communication has been established. He records also the results of some interesting tests he has recently completed in the Southern Pacific in an effort to determine the distance over which the New Zealand and Australian stations can be worked. Although the tests were carried out with the hope of extending the range of the New Zealand stations, it would appear that any process of steadily increasing the distance would not apply, and that definite areas are to be found where communication is possible, while in other localities the conditions are less favourable. The field of research work thus opened by the amateur, places him in a position to investigate a problem of immense importance, and it is difficult to foresee the results to which this contribution to the science of wireless telegraphy may lead.

IN TOUCH WITH NEW ZEALAND.

By E. J. SIMMONDS

(G 2 OD).

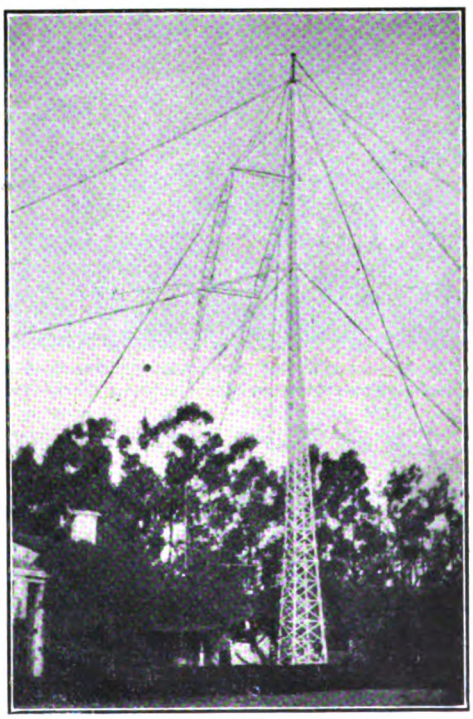
IN view of the great interest aroused by the experimental two-way tests with New Zealand, it is thought that a short description of the incidents connected with the reception of the first New Zealand amateur station heard here, and the apparatus employed at **G 2 OD** in this and the subsequent two-way tests, may be of interest.

On October 16th last, at 0600 G.M.T., **U 5 MI** was strongly received sending CQ, and using code word "ALABAMA," and at the conclusion of this transmission, while searching around 80 metres, a station was tuned in calling **U 5 MI**, and signing **Z 4 AG**. The signals were of good strength, easily readable and very steady, the note being a low musical A.C. one.

At first the great importance of this reception was not fully realised, as it seemed so improbable that it really could be a New Zealand station. Shortly afterwards, however, at 0630 G.M.T., **Z 4 AG** was heard again, much stronger, calling **U 6 ARB**, but apparently was unable to connect with either of the American stations.

At this time the writer suddenly remembered that in a recent issue of *Q.S.T.* **U 6 ARB** was reported as the strongest U.S.A. station heard in New Zealand.

At once the transmitter at **G 2 OD** was started up, and **Z 4 AG** given several long



The aerial at the New Zealand station **4 AA**, *owned by Mr. F. Dillon Bell of Waihemo, Otago. In conjunction with English amateurs this station has established a world's record for long distance communication.*

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calls, but without result, the probable reason being that the New Zealand station was listening on the 75 to 80 metre band used by the Americans, and **G 2 OD** was transmitting on 95 metres.

The next day (Friday) careful watch was kept during the same period, but no New Zealand signals were logged, although frequent calls were transmitted from this station.

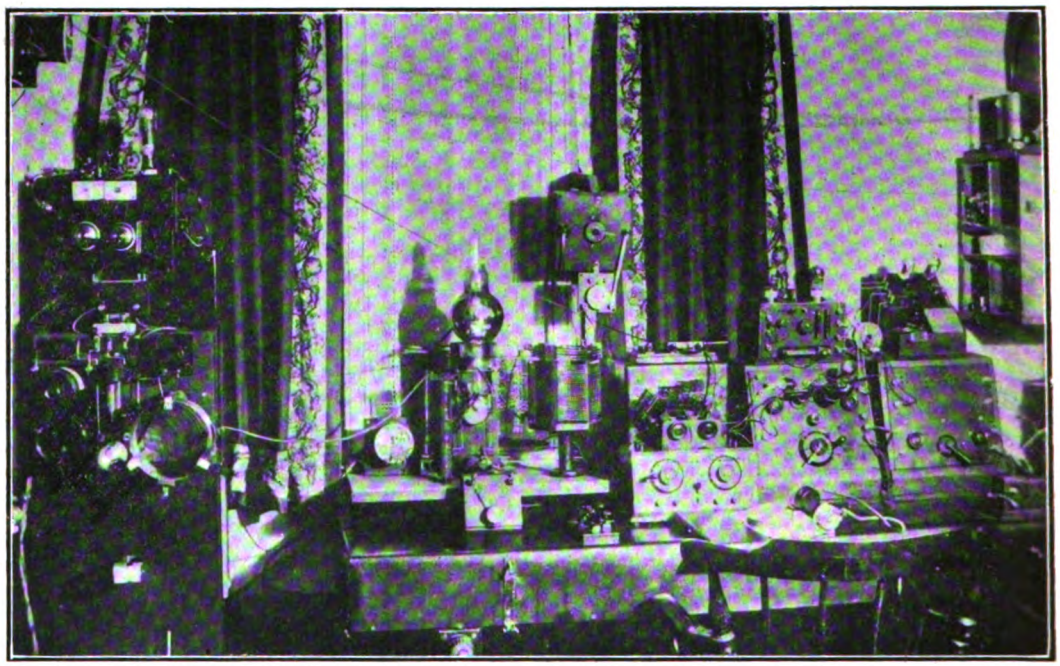
However, from evidence which has since come to hand, these calls were strongly received in New Zealand by **Z 4 AA**, **G 2 OD** thus being the first English amateur station heard in the Antipodes. The telegram received from **Z 4 AA** confirming this reception reads as follows :—

> " To E. Simmonds, Gerrard's Cross. Your signals loud calling Zinco and Americans Six-Thirty Friday Morning, Congratulations.
>
> (Signed) " BELL, WAIHEMO."

It should be explained that it has been the practice at **G 2 OD** when operating to send out calls embodying a code word at sunrise for obvious reasons, and the word " Zinco " was the code word used at 0615 G.M.T. on Friday, October 17th.

There is a note in the log regarding the conditions on October 16th which may be of interest, and reads, " Temperature moderate, light QRN, steady air, and clear sky."

On October 19th, at 0615 G.M.T., **Z 4 AA**, with D.C. note, was logged QSA, working **G 2 SZ** and later **G 2 KF**, and on the 20th at 0715 G.M.T., two-way communication was established between **Z 4 AA** and **G 2 OD**, the British signals being reported QSA.



The equipment at **2 OD**, *the station of Mr. E. J. Simmonds at Gerrard's Cross. Mr. Simmonds was the first English amateur to report the reception of signals from New Zealand. He heard* **Z 4AG**, *operated by Mr. Ralph Slade at Dunedin, on the morning of October 16th, which was later confirmed by cable. He subsequently established two-way working. This station was the first English transmitter to be heard in the Antipodes.*

Up to the time of writing, this station has worked two-way with **Z 4 AA** four times, and **Z 4 AG** twice.

The strongest New Zealand signal here is **Z 4 AK**, using rough unrectified A.C. note, which is difficult to read through any interference.

A report has also been received that **G 2 OD** has been heard in Sydney, Australia, and logged by **A 2 DS** there, but full details are not yet to hand.

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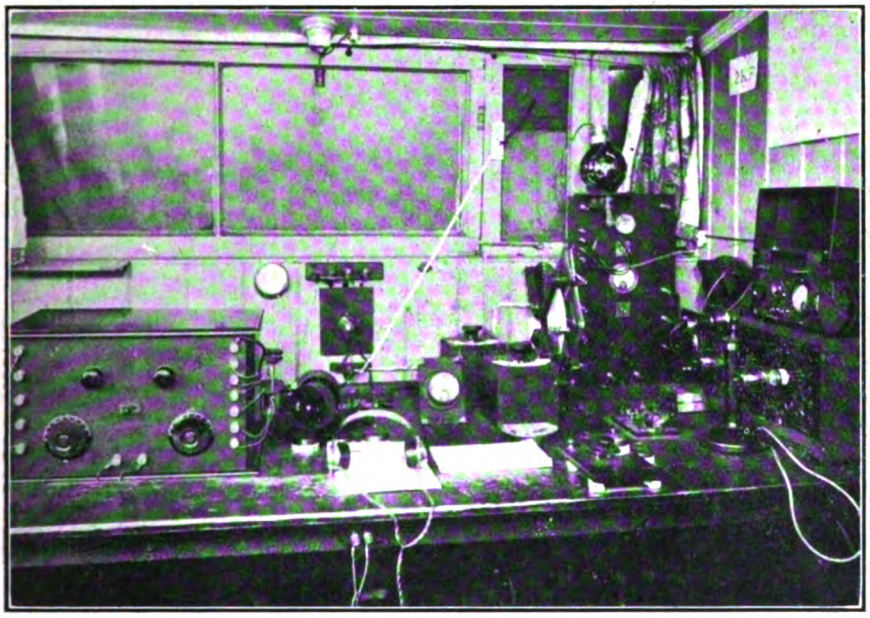
The transmitter used here is a master oscillator, the power supply being 50 cycles A.C., stepped up to 1,500 volts, and rectified by synchronous rectifier. The power amplifier is a Mullard O 250 C., with an anode input of 106 watts, and only 5·5 volts A.C. on the filament (12·5 volt rating), and it is a great tribute to the flexibility and efficiency of this valve. The receiver is a superheterodyne employing five valves.

The photograph shows, on the extreme left, the master oscillator panel and H.T. transformer; in centre, power amplifier and coupling transformer, also aerial series condenser; to left, superheterodyne and general purpose receivers. The aerial is a 6-wire cage, 72 ft. long including lead-in, 40 ft. high, badly screened by trees, and counterpoise six-wire fan, 48 ft. long and 9 ft. high.



The apparatus at **2 KF.** *Mr. Partridge, who operates this station, will be remembered as the first British amateur to establish two-way working with the United States. He is now working with New Zealand.*

THE WORK OF 2 KF.

By J. A. PARTRIDGE.

THE experimental equipment of this station has been previously described at some length and it is proposed to deal essentially with the several additions and changes that have been effected and are perhaps worthy of note.

Although the circuit itself remains as described and is the same as that employed for the first two-way communication with the United States late last year, the components forming this circuit have been modified with a view to reducing the losses so well known to exist on the shorter wavelengths. The tuning inductances have been replaced by spiral coils wound with copper strip and supported with cross arms, and all connections have been overhauled and carefully soldered. Specially spaced air dielectric low-loss condensers are now employed in the aerial and counterpoise leads, and all switch gear and supports have been overhauled to eliminate possible leakage and loss. Copper strip is used for connecting up the circuit wherever possible and it is interesting to note that an increase in aerial current for a given input was observed as soon as the set was rewired to this arrangement.

As to the receiving apparatus, an additional stage of L.F. amplification has now been fitted which is not used, however, when searching for distant C.W. transmitters such as the "Z" stations. The original aerial, which was a 3-wire inverted "L," has

* *Wireless World*, Vol. XIII, December 27th, 1923.

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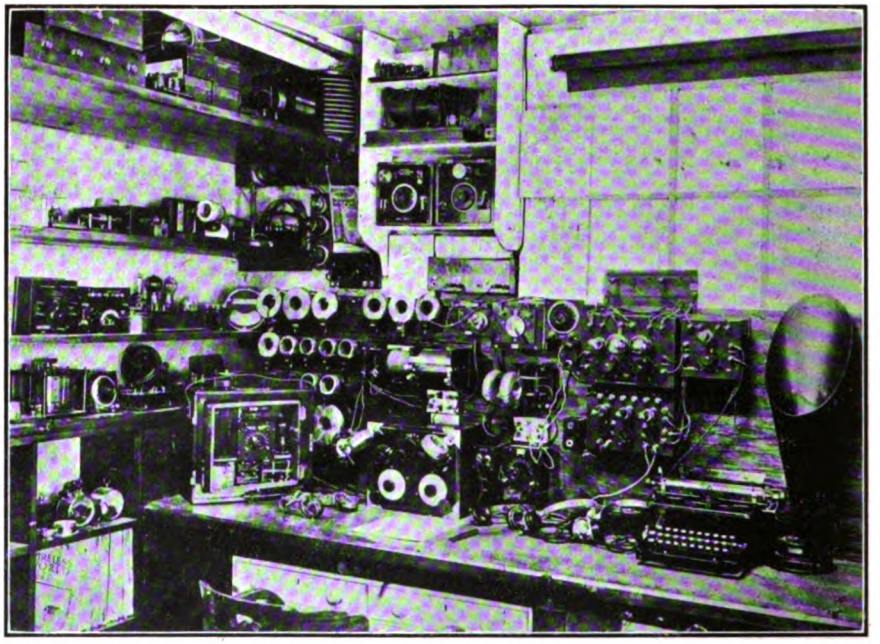
given way to a 6-wire cage with cage lead-in and the height of the supporting masts has been increased to 60 ft. The counterpoise consists of seven wires arranged in a fan-shaped formation and is suspended 7 ft. above the ground. Contact with the New Zealand Station **4 AA** was established at 6.25 a.m. on the morning of October 19th, and was thus the second successful two-way working with the Dominion. **Z 4AA** replied to the first call made by **2 KF** and he stated that he was receiving the English transmissions at good strength. Reliable communication was found to be possible until just after 7.15 a.m. G.M.T. Two messages* were passed each way, with the repetition of only one word and many comments were made as to signal strength. It is interesting to note that the New Zealander called **2 KF** by the name of its operator and this was indeed a surprise, coming as it did from over 11,000 miles away.

During the transmissions a message was received addressed to **G 2SZ**, the station of Mr. Goyder. This message was from the Prime Minister of New Zealand and another was received addressed to Sir James Allen, the High Commissioner of New Zealand in London. A reply to this latter message was successfully passed by **G 2KF** to **Z 4AA** two days later.

It would appear that at the present time



The receiving equipment at **Z 4AA** *as it appeared about two years ago. It is interesting to observe that all of the apparatus is of British manufacture. The products of several well-known companies can be identified.*

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* *Extract from Log.*

Text of some of the messages passed :—

No. 1. *From* **Z 4AA** *Waihemo, N.Z., to* **G 2SZ** *via* **G 2KF. Compliments from Prime Minister of New Zealand. Bell.**

No. 2. *From* **Z 4AA** *Waihemo, N.Z., to* **Sir James Allen, Strand, London. Greetings from Home. Bell.**

No. 1. *From* **Radio Society of Great Britain to Radio Society of N.Z.** *via* **Z 4AA. Congrats on achievement and greetings from R.S.G.B.** *G. 2KF*

The following message was sent in reply to 4 AA's No. 2 of 19th to Sir James Allen.

No. 3. *To* **Z 4AA** *from* **Sir James Allen. So far and yet so near. Congratulations.**

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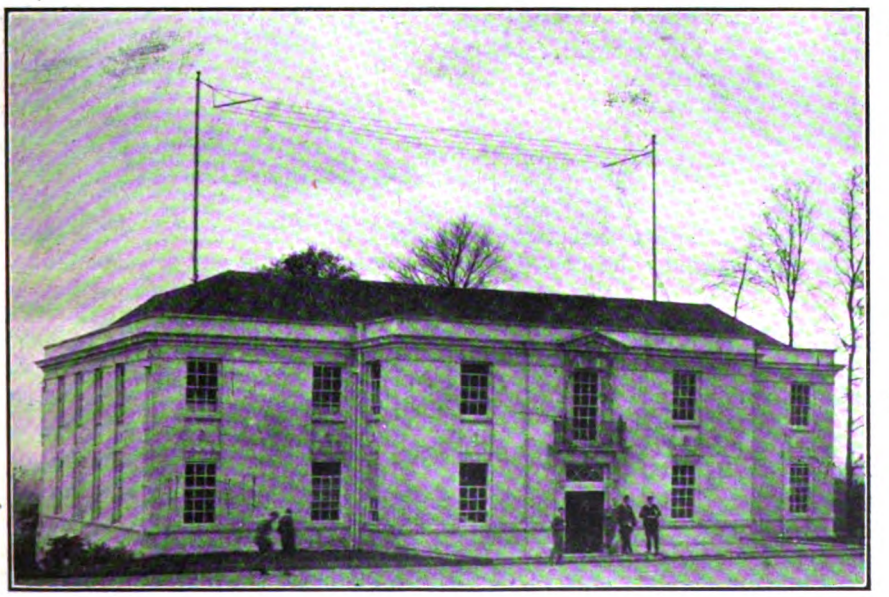
the New Zealand stations experience little or no difficulty in reading the signals of the English stations. It rarely happens that a reply is not received immediately from one or other of the three "Z" stations when called during the hour or so when communication is possible.

At the time of writing only three New Zealand stations have been logged at **G 2KF** and these are **Z 4AA, Z4AG** and **Z4AK**. The former transmissions resembled what might be termed a pure D.C. note, while the other two used A.C. as a source of power, which renders their signals difficult to get when interference is experienced.

A strange observation, and one which is rather difficult to explain, is that the signal strength of the three stations varies and each in turn may be received quite strongly with the others barely audible. It is difficult to give a cause for this as the three stations are situated so close together, **4 AG** and **4 AK** being located in the same town of Dunedin. It is highly improbable that the power inputs of these stations would fluctuate in this manner, and more improbable still that the operators would introduce changes in their circuits having once established contact with this country. Another point of interest is the almost entire absence of American stations operating on a wavelength of 80 metres during the time that our stations are working with New Zealand.

It would appear, moreover, that our two-way working with the Antipodes is not intercepted in America, although our signals may be passing across their country. Again it has been noticed that when the signals from England become unreadable in New Zealand, the New Zealand station **Z 4AG** has been heard calling **CB8**, the Argentine station with whom it is understood the New Zealand stations carry out extensive tests.

Mr. Goyder **(2 SZ)** *who was first to obtain two-way working between England and New Zealand.*



The aerial at the Mill Hill School **(2 SZ)** *used for communicating with New Zealand.*

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Much interference is experienced in the London area from the several transmitters employing wavelengths between 80 and 90 metres, which is the band used by the New Zealand stations. The remedy is quite simple. Use wavelengths above 90 metres where the New Zealand stations will be searching and do not make a call until some indication has been received from the distant stations.

It might be added that the Australian station **2 DS** reports having heard the signals of **G 2OD** (Mr. E. J. Simmonds) and **G 5LF** (Mr. K. Secretan) and it would appear that we shall soon be satisfactorily working with the Australian Continent.

SOME OBSERVATIONS ON COMMUNICATING WITH NEW ZEALAND

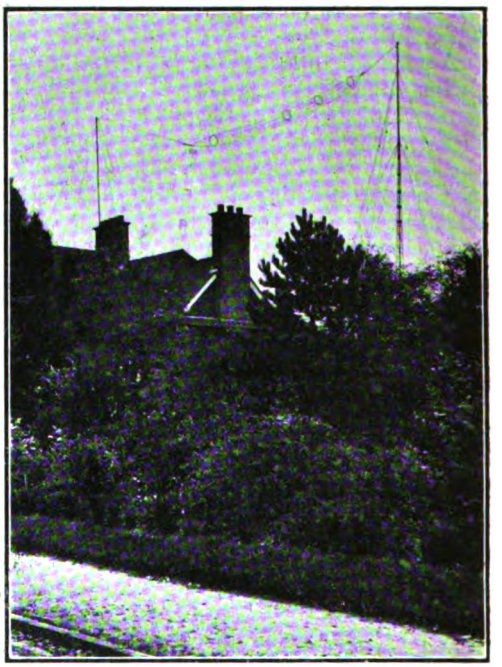
By GERALD MARCUSE **(2 NM.)**

ENCOURAGED by the results obtained at my station from December to April, when two-way communication was carried out almost entirely with the United States and Canada, and profiting by the valuable data gained, I fully realised, as I have previously predicted, that this year would prove even more successful than ever so far as long distance amateur communication was concerned. During operations last winter it was found possible to work with forty-one Canadian and American amateurs, and the signals from **2 NM** were received North, South, East and West, throughout the American Continent. I do not propose to give full technical details here as these have been already published, but I will refer only to the alterations which have been introduced in the hope of improving the operation of the set.

A 25 ft. extension has been added to my 65 ft. steel lattice mast, making the height at the free end about 90 ft., while the height at the house is 65 ft. The aerial is an eight-wire cage, 2 ft. in diameter, with a six-wire lead-in, while the insulators for both aerial and counterpoise are further spaced from the earthed supporting wires by inserting them in plate glass squares. A source of high tension is obtained from a special generator built for me by Messrs. Mortly Sprague & Co., Ltd., which will deliver a current of 330 milliamperes at a potential of 3,000 volts, and when working on full power a current is obtained in my aerial system of 3 amperes, on the wavelength adjustment of 96 metres.

For reception a special low loss set was employed which was made up for me in Montreal, and is a two-valve set employing a detector and low frequency amplifier.

The many American and Canadian amateurs which had been worked, and from the reports gathered I could see that my labours were not altogether in vain, and when



The aerial at **2 NM.** *It is an eight-wire cage* **90** *feet in height at the mast end.*

using 300 watts and a Mullard O 250 valve as oscillator, communication was established with **1 HT**, which is an Italian destroyer, with an old friend, **ACD**, as operator. He told me that he had logged my signals well south of the equator. The Canadian Government steamer "Arctic" (**VDM**) also gave me a very encouraging report.

Unfortunately I was laid up when the New Zealand stations were first heard in this country, but when Mr. Goyder rang me up and told me the joyous news I was compelled to brave the doctor's orders. I crawled out of bed on the morning of October 19th and called up New Zealand, and was more than

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gratified to hear **Z 4 AK** and **Z 4 AG** both calling me. Working was carried on with the latter station until his signals faded out, and during the course of this transmission the New Zealand station reported my signals to be of good strength. On October 21st my call was replied to by **Z 4 AK**, while on October 25th I again worked **Z 4 AG**, this time using about 900 watts, my previous working having been carried out with a power of 300 watts. I also heard **Z 4 TE** calling, and although replied communication was not established. It is just as well to announce here that the New Zealand stations are testing with Australia between 5 and 6 p.m. G.M.T., while the Australian transmitters endeavour to establish communication from 6 to 7 p.m. G.M.T. In connection with these tests I have heard **Z 4 JA** calling during these hours. Those interested in short wave working should certainly make a point of listening-in to these tests.

The reception of signals from New Zealand is rather curious. The signal strength may be fairly weak at the start, gradually increases, and then drops off again and gradually fades away. The period of audibility in this country seems to be about one hour, and on some occasions a little more, and is timed from 6.15 a.m. till 7.30 a.m. G.M.T.

Another observation of interest is that on Sunday morning, October 26th, the New Zealand station, **Z 4 AG**, sent out a general call, "CQ," and said that there was "nothing doing," although his strength here on two valves was the best I have yet heard from New Zealand. On the other hand, on Monday, 27th Oct., no signals were received from New Zealand, which is the first occasion for a week that this has occurred.

During the tests with New Zealand one observes that there would appear to be very little activity among the American and

Mr. Gerald Marcuse operates **2 NM** *and is actively engaged in working the New Zealand stations.*

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Canadian stations, and so far as my own station is concerned, nothing has been heard in America since the Pan-American tests organised by the American Radio Relay League, extending from October 15th to 24th.

In recording the results of international communication it might be mentioned that very few American and Canadian amateurs have been heard calling the Argentine, although from letters received from Major Borrett and others in America **CB 8** is coming in well there, although two-way communication between Canada and the Argentine is not yet possible.

In a recent letter Canadian **IDD** (Major Borrett) states that **G 2 OD** (Mr. Simmonds), **G 2 KF** (Mr. Partridge), **G 5 LF** (Mr. Secretan), and my own station (**G 2 NM**), come in very well at his station, and that he has called us on 80 metres. Though I have listened very carefully for his signals I have heard nothing, and this is all the more curious as it is occurring at a time when the signals from New Zealand are coming in so well.

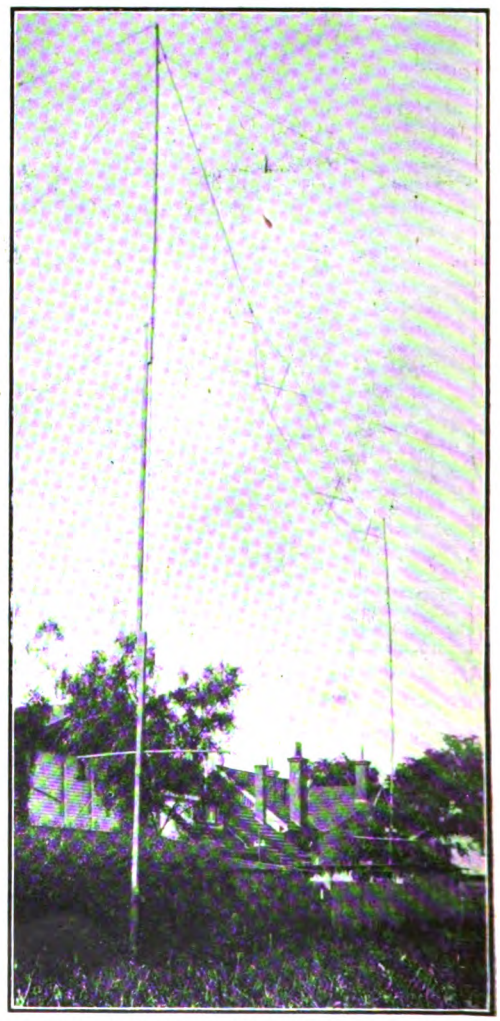
In conclusion, I would like, through these columns, to thank those gentlemen who have so kindly sent me telegrams and letters as a result of having overheard my two-way communication with New Zealand. I would like also to request those amateurs who are using wavelengths below 90 metres to refrain from doing so during this period, when communication with New Zealand is being developed, as they are very liable to interfere with the success of long range work.

AMATEUR RADIO IN NEW ZEALAND

R. J. ORBELL, B.E. (**Z 3 AA**).

COMING at a time when Imperial communication by wireless is such a widely debated subject, it is surely a significant fact that the honour of being the first to establish direct touch with the Antipodes should fall to the lot of a British amateur. This is more particularly the case when one considers the fact that communication was, and continues to be established using the remarkably low power of two hundred watts input. When one realises that the energy expended in covering the 11,000 miles to New Zealand is very little more than that consumed by an ordinary incandescent electric lamp, this feat appears even more remarkable, and one conjures up visions of what must inevitably come in the near future. In a few years time, at the present rate of progress, anyone with a simple set such as those now used for listening-in to broadcasting, will no doubt be able to converse freely by word of mouth with a friend in any part of the world.

I have lately arrived in England from New Zealand, and the three amateurs in the latter country, who have already "got over" to England, are well known to me personally. I shall endeavour therefore to give a short description of their stations and of radio in New Zealand as a whole. I shall also describe briefly some two-way tests which I conducted on the s.s. "Port



The aerial of **Z 3AA** *at Christchurch, New Zealand.*

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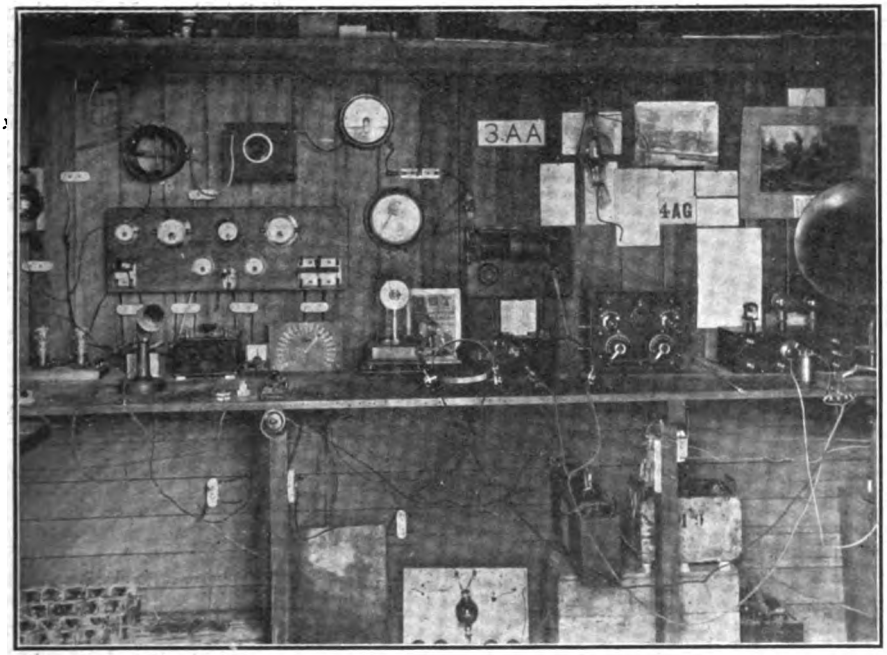
Curtis" on the voyage to England *via* Cape Horn.

It was not until early in 1923 that the official ban on amateur wireless in New Zealand was raised, and regulations were framed giving the experimenter a reasonably free hand to carry on such work as he chose.

Although these regulations provided wavelengths ranging from 180 to 140 metres, no restrictions were imposed on the use of still lower waves, as it was then generally considered that waves in the neighbourhood of 100 metres were unworkable. Transmitting licences were divided into two classes—Grade 1 and Grade 2, the holders of the former being allowed fifty watts input and the latter five. To obtain a licence it was necessary to pass an examination embracing theory, morse code and the regulations. Ten words per minute were required for a Grade 1 licence and eight for a Grade 2. These licences were being revised when I left New Zealand and the intention was to have one grade only and eliminate Grade 2 altogether, thus allowing everyone the use of fifty watts. The figures prefixing the call signs allotted are as follows:—Auckland District 1, Wellington District 2, Canterbury District 3, and Otago District 4. Other outlying Provinces are included in the above radio districts. Thus no calls have any figure greater than 4. The regulations are well thought out, and are also flexible as regards power and wavelength if special tests or experiments are to be conducted at any time.

For the first six months apparatus was exceedingly difficult to obtain, more particularly valves, as these all had to be imported from either England or America, hence their chances of arriving intact were more or less uncertain. However, after a time various firms imported valves in bulk and this difficulty was overcome. Our experiments for the first year consisted for the greater part in "putting over" gramophone concerts which were not (as one might expect) of a very high class nature.

Then we began to hear amateurs in Australia, which is, on an average, about 1,400 miles from New Zealand. Tests were



The equipment at **3 AA**, *the station of Mr. R. J. Orbell, a well-known New Zealand experimenter. He has just arrived in this country and he describes the New Zealand stations participating in the communication tests with this country.*

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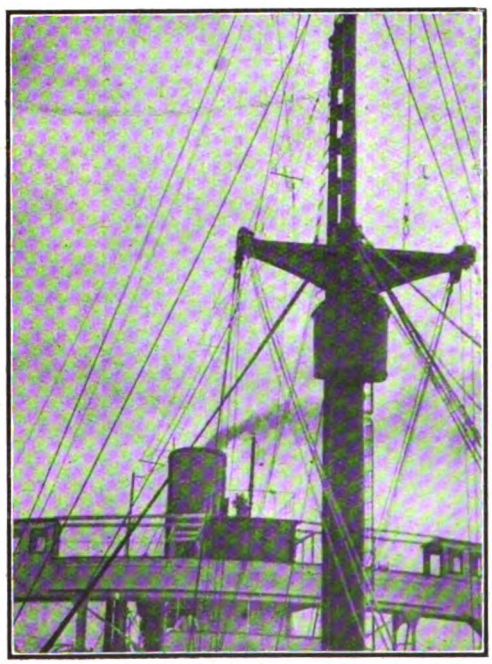
arranged, first between individual stations in both countries and then between the Radio Society of Christchurch and the various Australian societies which had been formed. These tests proved quite successful, and eventually clear two-way conversations were made on both morse and speech. Low power working was tried and on one occasion Mr. Jack Davis, **A 2DS**, a prominent Sydney experimenter, got over to Mr. Bell, **Z 4AA** (now so well known to amateurs in England) with less than half of one watt input.

Signals from American amateurs had been heard in New Zealand and Australia for some time, but two-way tests arranged with the A.R.R.L. proved unsuccessful, although many American signals from all districts were received with great strength. Towards the close of 1923, about six New Zealand and ten Australian stations were in operation, all using an average input of about 30 watts. During 1924 considerable progress was made and when I left New Zealand early in September there were many more transmitters working.



The cage aerial fitted on the s.s. "Port Curtis" and used by Mr. Orbell for experimental work with Australian and New Zealand amateurs. It is 50 ft. above the deck. Little difficulty was experienced in working **A 2DS, A 3BQ, Z 4AA, Z 4AG, Z 4AK, Z 2AC,** *up to a distance of 5,000 miles on the outward route from New Zealand to Cape Horn.*

It occurred to me that if I installed my own transmitter and receiver on board the ship *en route* to England, and if a series of nightly tests were arranged, that an excellent opportunity would be afforded of determining just how far the New Zealand signals were reaching. The only reports to date which had come from outside Australasia were several from the United States which claimed reception of **Z 4 AA**, all of which reports, with the exception of one, did not correspond with the latter's log. However, Mr. O'Meara (**Z 2AC**) on May 24th worked Argentine (**R CB 8**) at 6,400 miles, this being at that time a world's record for two-way amateur communication.

Permission to install my set on the s.s. "Port Curtis" was kindly granted by Amalgamated Wireless, Ltd., the Marconi representatives in Australasia, and by the Post Office and shipping authorities. With the assistance of **Z 4 AA** and some other friends, I built a four-wire cage aerial 50 ft. long, and erected it from a point on one of the masts 50 ft. above the deck to a small pole lashed to the bridge. It was badly screened by the main ship's aerial and by numerous mast stays, etc., but was the best we could do under the circumstances. A lead-in was brought through a ventilator into the wireless cabin, where, through the kindness of Mr. Boorne, the ship's senior operator, we had arranged to place our gear. The apparatus was, however, necessarily rather cramped. The transmitter, which I had rebuilt for the purpose, was arranged to be attached to the wall, and occupied a space of only 15 ins. by 12 ins.

A shunt Hartley circuit was used with 600 volts H.T., supplied by a B.T.H. aeroplane generator. This latter was belted to a ¼ H.P. direct current motor run by the ship's supply mains. A 250 watt Marconi-Osram valve was operated on low power with an actual input of only 60 watts, as this was all that the generator would deliver. Better results were obtained in this way than by running several smaller valves in parallel. My receiver consisted of a detector and one note magnifier, with "low loss" inductances employing an aperiodic primary of four turns. When we put to sea it soon became evident that owing to "swinging" caused by the rolling

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of the vessel it was impossible to use a wavelength lower than 125 metres, except during very calm weather. Hence this was used almost all the time.

The ship left Napier as its final port on September 4th, bound for Cape Horn. A schedule for working had been arranged, including that I should listen every night for New Zealand and Australian amateurs from 8 p.m. till 8.30 p.m. I was to reply at 8.30, giving calls heard, and then try to work anyone whose signals I heard. I decided to use my Christchurch call (**3 AA**), and in order that no confusion would be caused by the use of the "intermediate" **Z**, I substituted **X** instead. I kept a complete log of New Zealand and Australian calls heard and stations worked, but will mention here only the more important results obtained. Little difficulty was found in working **Z 4 AA, Z 4 AG, Z 4 AK, Z 2 AC**, and all the principal stations up to 5,000 miles, including **A 2 DS** and **A 3 BQ**, who were very consistent, the former using 25 watts input only. **Z 3 AL**, using 12 watts, was worked at 4,600 miles, and heard when we were rounding Cape Horn at 5,100 miles. I managed to work **Z 2 AC** every night till we arrived at Montevideo, at which place he reported my signals as being strong. This was a distance of 6,500 miles—just 100 miles further than the previous record by **Z 2 AC**. The latter tried modulation tests, and clear speech was received from him till the ship was approximately 300 miles S.W. from Montevideo. After leaving the latter port we experienced a period of very heavy atmospherics, which lasted for most of the remainder of the journey to Las Palmas. As we were now in tropical waters this was to be expected, and, as a result, two-way working with New Zealand became impossible.

However, **R CB 8** at Buenos Aires, whom I had worked every evening from Cape Horn onwards, and who had hooked up with **Z 2 AC**, now acted as a relay station, so I was still in touch though not directly. The New Zealand stations were still audible, but it was only during lulls in the bad weather that their calls were recognisable. **Z 4 AG** and **Z 4 AK** were occasionally heard till we were off Pernambuco, and **Z 2 AC** was the last one to be heard, distinctly calling **RCB 8** and myself, when the ship was 70 miles north of the equator, at a distance of nearly 10,000 miles. This latter call was heard when the sun had been shining for over an hour, and the atmospherics had decreased as a consequence. A few days before this **Z 2 AC** had effected two-way communication with **R DB 2**, Dr. Cattaneo, of Bahia Blanca, whom I had also worked frequently when going up the coast. **R CB 8** and I arranged a schedule as far as Las Palmas, but atmospherics rendered signals unintelligible after we were about 3,000 miles apart.

British **G 2 KF** and **G 2 OD** were heard very strongly several times when we were passing Pernambuco, as was also Mr. Ducati, who was on the Italian warship "San Marco" **IHT** somewhere near the African coast. When we reached Las Palmas in the Canary Islands I dismantled the set in order to have it packed up ready for arrival in England some days later.

There were several, rather interesting occurrences that were noticeable during the voyage. One was that the U.S. amateur signals which were constantly heard, reached a maximum strength about half-way across the South Pacific, and faded out very considerably later when the South American Continent intervened.

Later, in the Atlantic, near Las Palmas, they returned to nearly the same strength as previously. This appeared to point to a decided screening effect due to the land between us and the United States. Another noticeable effect was that as we became more and more distant from New Zealand, the fading of the New Zealand signals became gradually less noticeable, till at the maximum distance it almost entirely disappeared.

On my arrival in England on October 18th, it was indeed an agreeable surprise to find that **Z 4 AA** had actually been worked that same morning by Mr. Goyder at the Mill Hill School station **G 2 SZ**. That this was not merely due to "freak" conditions becomes increasingly evident, as several other stations at both ends have now been similarly successful, these others being, at the time of writing, **G 2 KF, G 2 NM** and **G 2 OD** in this country and **Z 4 AG** and **Z 4 AK** in New Zealand. Both **Z 4 AG** and **Z 4 AK** are using inputs in the neighbourhood of 250 watts. **Z 4 AA**, whose station I know intimately, he himself being a personal friend, is using from 100 to 150 watts in a close coupled shunt Hartley circuit.

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He generally uses one UV 203 American valve rated at 50 watts output, supplied by a B.T.H. aeroplane generator similar to my own, with another machine in series, the total H.T. voltage amounting to about 1,200 volts. Power is derived from a 110 volt Delco lighting plant. The aerial is supported at one end by a wooden lattice tower 96 feet high, and at the other end by an Australian blue-gum tree 90 feet high stripped of its branches. The aerial itself is 30 feet long and consists of a double cage attached to spreaders. A cage lead-in is brought from the centre of the 30-ft. span, directly down to the operating room. The counterpoise is a multiple wire fan arranged directly below the aerial and about 15 feet from the ground. With this system, an aerial current of about 1·3 amperes is obtained on 100 metres.

While the station itself is on high ground over ten miles from the nearest town, Palmerston South, it is nevertheless enclosed on two sides by neighbouring hills of about 2,000 feet high.

It is a strange thing that, as far as I am aware, the only New Zealand stations reported to date are situated within a radius of 50 miles in the southern part of the country, while **Z 2 AC** and others in the North Island have not yet been heard in England. In this connection, it is interesting to note that the long wave high power stations in Europe are received much more strongly in the district where the successful stations are situated, than they are further north. This seems to suggest a possible concentration at certain points near the Antipodes of the waves from the various European stations. Another interesting fact is that these long wave European stations are received at maximum strength about 6 a.m. New Zealand time, corresponding to 6.30 p.m. Greenwich time, while amateur tests have so far been unsuccessful at this time. These are matters which can be elucidated only by constant and systematic experimenting.

REPORTS FROM A LISTENER IN FRANCE.

By J. L. MENARS, France. **(F 8 FJ.)**

DURING the period October 20th to 25th, signals from the New Zealand stations have been intercepted. Using a three-valve receiver the New Zealand station **4 AA** comes in exceedingly loud and equal in strength to the strongest of the N. American amateurs.

A surprising thing is the ease with which the New Zealand signals can be received on a comparatively small aerial. The best time for working I find to be between 6 and 7 a.m. G.M.T., and, as to wavelength, I observe that **4 AG** is working on 80 metres, while **4 AA** employs a wavelength of 89 metres.

As regards the communication tests, the several European stations in communication would appear to be **2 OD** (Mr. Simmonds), **2 NM** (Mr. Marcuse), **2 SZ** (Mr. Goyder), **2 KF** (Mr. Partridge), and **5 LF** (Mr. Secretan), also the French station **8 BF** (M. Pierre Louis).

Mr. J. L. Menars, of Province Gan, a French amateur who is intercepting the New Zealand transmissions.

Mr. J. H. R. Ridley **(5 NN)** was heard in New Zealand on the morning of October 22nd by **Z 4AA.** The wavelength used for the transmission was 99 metres.

* * * *

Mr. Frederic L. Hogg **(2 SH),** using an aerial 40 feet in length and about 15 ft. in height, has been heard by **Z 4AA.** Mr. Hogg reports reception of **Z 4AA** and **Z 4AG.**

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Mr. R. L. Royle **(2 WJ)** worked with **Z 4AA** on October 29th. He reports having heard **2 AC** working on a wavelength of 85 metres.

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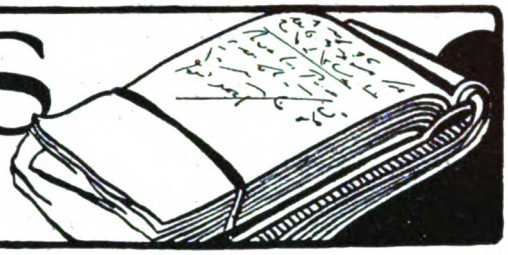
NOTES & NEWS



Satisfactory tests have been made from a new German broadcasting station at Bremen.

* * * *

Short-wave transmissions from **KDKA**, Pittsburg, have been heard within 11 degrees of the North Pole by the operator of the Canadian Government steamship *Arctic*.

* * * *

The value of wireless apparatus manufactured in the U.S.A. during 1923 amounted to £8,692,000.

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The Ecole Supérieure station has again changed its wavelength, states our Paris correspondent, and now transmits on 458 metres. The *Petit Parisien* wavelength is now 346 metres.

* * * *

CAPTAIN IAN FRASER'S SUCCESS.

To wireless amateurs an interesting feature of the past election has been the returning to Parliament of Captain Ian Fraser, C.B.E., as Conservative member for North St. Pancras.

Captain Fraser, who was blinded on the Somme in 1916, is well known, not only as Chairman of St. Dunstan's, but as a keen wireless experimenter, a member of the Council of the Radio Society of Great Britain, and Chairman of the Transmitter and Relay Section. He is an active transmitter and owns the call sign **5 SU**.

RECORD LOOP AERIAL RECEPTION.

Broadcast reception with a loop aerial over a distance of 7,500 miles is reported from Johannesburg. On the night of September 27th, several experimenters, with a four-valve receiver and McMichael loop aerial heard the Pittsburg station, **KDKA**. This appears to be a record for loop aerial reception in South Africa, and has roused great enthusiasm in the Press.

NEW SPANISH BROADCASTING STATIONS.

The Radio Iberica Co. of Spain has inaugurated a new broadcasting station at Seville, and concerts are to be sent out daily from 7 to 9 p.m. A low power broadcasting station is also to be installed at Barcelona, employing a Western Electric 100-watt transmitter. At present we have no information as to the call signs of these stations.

ITALIAN AMATEUR'S GOOD RECORD.

An Italian amateur station whose signals have become increasingly familar to British listeners, is **1 FP**, the owner of which is Signor Franco Pugliese, of Milan.

We are indebted to Signor Pugliese for some interesting details of his work during the past summer. Although surrounded by very high mountains, **1 FP** has been heard in nearly all European countries, and Finnish **2 NM** has reported the Italian's signals as R 9 on two valves. Two-way working has been established with more than forty foreign amateurs. A new transmitter is now being designed for participation in the Transocean

Captain P. P. Eckersley, Chief Engineer of the B.B.C., photographed while on his recent visit to America. On the left is Mr. A. J. Haynes, the well-known designer of receiving apparatus, and on the right Mr. Arthur Lynch, Editor of "Radio Broadcast," of New York, organising the international broadcasting tests on the American side.

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Tests, and we hope that **1 FP** will meet with the success which his previous record would seem to promise.

WIRED WIRELESS FOR BROADCASTING.

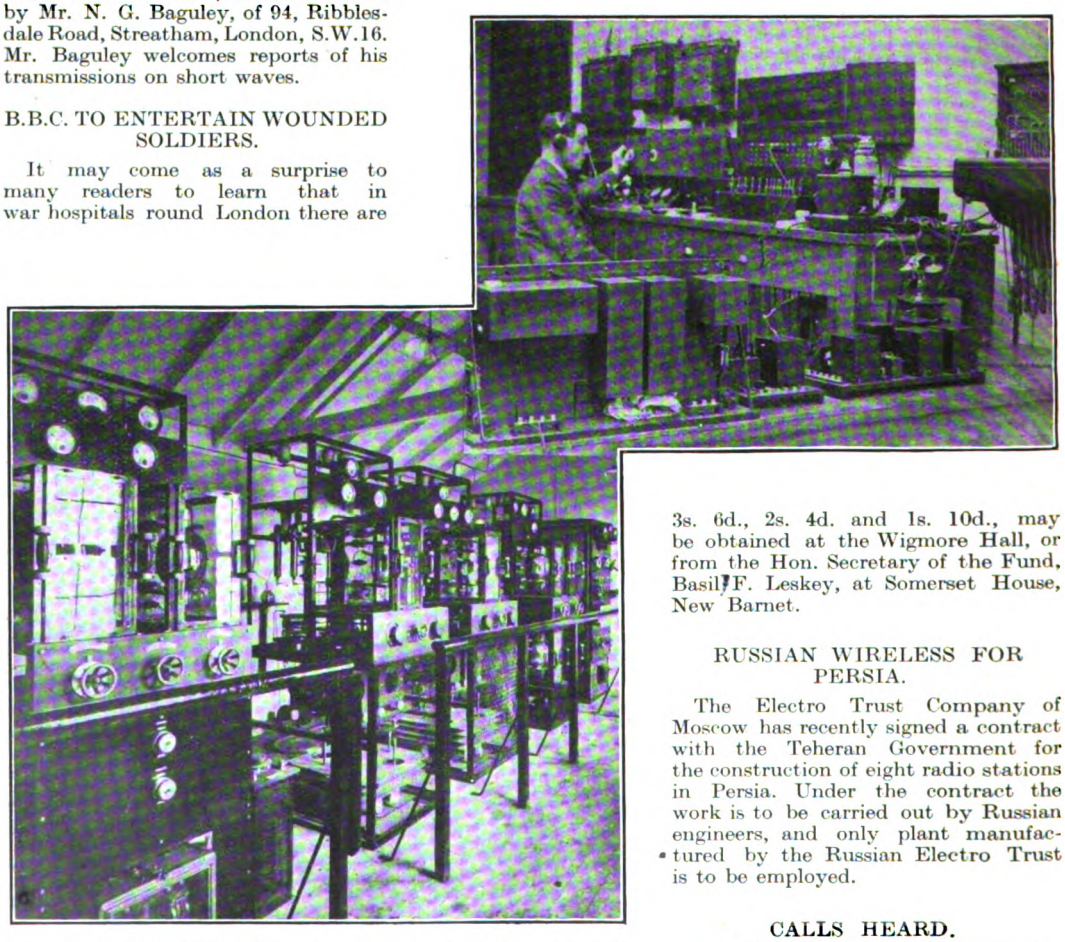
Much interest has been aroused in Germany by the successful application of "wired wireless" in connection with broadcasting. Preliminary experiments have been carried out in Saxe-Altenburg, and on October 23rd a programme was transmitted on this system to Rositz from Berlin *via* Leipzig. From Rositz it was sent out on the mains carrying a potential of 22,000 volts. The chief merit of the "wired wireless" system is its cheapness. A very low-powered transmitter can be employed, and the receiving apparatus is of usual design. Moreover, the primary functions of the power and conductors are not interfered with in any way.

2 NB.

The above call sign, originally the property of a Cheshire transmitter, is now owned by Mr. N. G. Baguley, of 94, Ribblesdale Road, Streatham, London, S.W.16. Mr. Baguley welcomes reports of his transmissions on short waves.

B.B.C. TO ENTERTAIN WOUNDED SOLDIERS.

It may come as a surprise to many readers to learn that in war hospitals round London there are still 5,000 badly wounded soldiers. With the object of brightening the lives of these unfortunate sufferers, the *Adair Wounded Fund* has consistently, for nearly four years, provided them with weekly entertainments. Ninety-four of these entertainments have already been held in the Wigmore Hall, Palladium and elsewhere, but on the afternoon of Sunday, November 23rd, a "special" event takes place at the Palladium, when the British Broadcasting Company will act as hosts, providing the expenses for the entertainment and the tea. Over 600 wounded soldiers will be present to enjoy a "surprise" programme contributed by John Henry and "Blossom," Miss Isobel Elsom, Miss Phyllis Dare, Mr. Ben Lawes, and other popular artistes. This is one of the two yearly matinees to which the public are admitted, and to cover the inevitable "out-of-pocket" expenses (the artistes are giving their services free) it will be a gracious act if wireless folk turn up in force to support the kindly efforts of the B.B.C. Tickets, price 5s. 9d., 3s. 6d., 2s. 4d. and 1s. 10d., may be obtained at the Wigmore Hall, or from the Hon. Secretary of the Fund, Basil F. Leskey, at Somerset House, New Barnet.



Two views of the Belfast Broadcasting Station, which was opened officially by the Duke of Abercorn at the end of October. Above: A scene in the control room. Below: The transmitting room.

RUSSIAN WIRELESS FOR PERSIA.

The Electro Trust Company of Moscow has recently signed a contract with the Teheran Government for the construction of eight radio stations in Persia. Under the contract the work is to be carried out by Russian engineers, and only plant manufactured by the Russian Electro Trust is to be employed.

CALLS HEARD.

In order to cope with the increasing number of Calls Heard sent in, we shall be compelled to exclude English calls for the next few issues.

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BROADCASTING.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:

GREAT BRITAIN.

CHELMSFORD 5 XX, 1,600 metres, Tests. **ABERDEEN 2 BD,** 495 metres; **BIRMINGHAM 5 IT,** 475 metres; **BELFAST 2 BE,** 435 metres; **GLASGOW 5 SC,** 420 metres; **NEWCASTLE 5 NO,** 400 metres; **BOURNEMOUTH 6 BM,** 385 metres; **MANCHESTER 2 ZY,** 375 metres; **LONDON 2 LO,** 365 metres; **CARDIFF 5 WA,** 351 metres; **RELAY STATIONS: LEEDS-BRADFORD 2 LS,** 346 and 310 metres; **PLYMOUTH 5 PY,** 335 metres; **EDINBURGH 2 EH,** 328 metres; **NOTTINGHAM 5 NG,** 322 metres; **HULL 6 KH,** 335 metres; **LIVERPOOL 6 LV,** 315 metres; **STOKE-ON-TRENT 6 ST** 306 metres; **SHEFFIELD 6 FL,** 301 metres. Tuesdays, Thursdays and Fridays, 1.0 p.m. to 2.0 p.m. (**2 LO** only). Regular daily programmes, 3.0 to 7.30 p.m., 8.0 to 11.30 p.m. Sundays, 3.0 to 5.0 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS ("**Radio Paris**"), **SFR,** 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.30 p.m., Exchange Prices; 4.30 p.m., Financial Report; 5.0 p.m., Concert; 8.30 p.m., News and Concert.

PARIS (Ecole Superieure des Postes et Telegraphes), 458 metres. 3.45 p.m. (Wednesday), Talk on History; 8.0 p.m. (Tuesday) English Lesson; 8.30 p.m., Concert; 9.0 p.m., Relayed Concert or Play.

PARIS (Station du Petit Parisien), 346 metres; 8.30 p.m., Tests.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 2.0 p.m. and 6.50 p.m., Meteorological Forecast.

BRUSSELS ("**Radio-Belgique**"), 265 metres. Weekdays, 5.0 p.m. to 6.0 p.m., and 8.0 p.m. to 10.0 p.m.; Sunday, 5.0 p.m. to 6.0 p.m., and 8.30 p.m. to 10.0 p.m.

HOLLAND.

THE HAGUE, PCGG, 1,070 metres. 4.0 to 6.0 p.m. (Sunday), 9.40 to 11.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres. 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9.0 p.m. (Thursday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres, Saturday, 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular), 8.40 to 10.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres, 9.0 a.m. and 5.0 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 8.30 to 9.45 p.m. (Weekdays), 8.0 to 9.0 (Sunday), Concert.

SWEDEN.

STOCKHOLM (Telegrafverket), 440 metres. Daily, 12.45 to 1.0 p.m., Weather Report and Nauen Time Signal; Monday, Wednesday and Saturday, 8.0 to 9.0 p.m., Concert and News; Sunday, 11.0 a.m. to 12.30 p.m., Divine Service from St. James' Church.

STOCKHOLM (Radiobolaget), 470 metres. Tuesday and Thursday, 8.0 to 9.30 p.m., Concert and News.

GOTHENBURG (Nya Varvet), 700 metres. Wednesday, 7.0 to 8.0 p.m.

BODEN, 2,800 metres. Tuesday and Friday, 6.30 to 7.30 p.m., Sunday, 5.30 to 6.30 p.m., Concert and News.

GERMANY.

BERLIN (Koenigswusterhausen), LP, 680 metres. Sunday, 10.50 to 11.50 a.m., Concert; 2,800 metres, Sunday, 11.50 a.m. to 12.50 p.m., Concert.

EBERSWALDE, 2,930 metres. Daily, 1.0 to 2.0 p.m., Address and Concert; 6.0 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (Vox Haus), 430 metres. 11.0 a.m., Stock Exchange; 1.55 p.m., Time Signals; 5.40 to 7.0 p.m., Concert; 7.0 to 8.0 p.m. (Sunday), Concert.

BRESLAU, 415 metres.

HAMBURG, 387 metres.

STUTTGART, 437 metres.

KONIGSBERG, 460 metres.

FRANKFURT-AM-MAIN, 467 metres. 7.30 to 10.0 p.m., Tests, Gramophone Records.

LEIPZIG (Mitteldeutsche Rundfunk A.G.), 452 metres.

MUNCHEN (Die Deutsche Stunde in Bayern), 485 metres.

CZECHO SLOVAKIA.

PRAGUE, PRG, 1,800 metres. 8.0 a.m., 12 a.m., and 4.0 p.m., Meteorological Bulletin and News; 4,500 metres, 10.0 a.m., 3.0 p.m., and 10.0 p.m., Concert.

KBELY (near Prague), 1,150 metres. Weekdays, 7.15 p.m. and 10.0 p.m., Sundays, 11.0 a.m. to 12.0 noon, Concert and News.

BRUNN, 1,800 metres. 10.0 to 11.0 a.m., Concert; 2.30 p.m., News.

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SPAIN.

MADRID, PTT, 400 to 700 metres. 6.0 to 8.0 p.m., Tests.

MADRID (Radio Iberica), 392 metres. Daily (except Thursdays and Sundays), 7.0 to 9.0 p.m. Thursdays and Sundays, 10.0 to 12.0 p.m., Concerts.

MADRID, 1,800 metres. Irregular.

CARTAGENA, EBX, 1,200 metres, 12.0 to 12.30 p.m., 5.0 to 5.30 p.m., Lectures and Concerts.

PORTUGAL.

LISBON (Aero Lisboa), 370 to 400 metres. Wednesdays and Fridays, 9.30 to 12.0 p.m., Irregular Tests.

SWITZERLAND.

GENEVA, HB 1, 1,100 metres. Weekdays, 3.15 and 8.0 p.m., Concert or Lecture.

LAUSANNE, HB 2, 850 metres. Daily, 9.15 p.m., Concert and Address.

ZURICH, HBZ, 650 metres. 1.0 p.m., News and Weather Forecast; 8.15 p.m. to 10.15 p.m., Concert.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 12.0 a.m. 1,800 metres, 4.0 p.m. and 8.30 p.m., Tests, Gramophone Records.

ROME, 422 metres. Weekdays 7.30 to 9.30 p.m.

Calls Heard

Felixstowe, Suffolk (from September 7th).
French: **8 AL, 8 BC, 8 BO, 8 CN, 8 DP, 8 FC, 8 FI, 8 FM, 8 FVQ, 8 MU, 8 NS, 8 PA, 8 RBR, 8 RLH, 8 VV, 8 WL, 8 XH.** Finnish: **FN, 1 NA.** Danish: **7 ZM.** Various: **1 MT, 2 CAA, 3 EA, 4 UU.** (o—v—1.) (H. J. Wright.)

The Hague, Holland (from September 20th to October 20th).
French: **8 AB, 8 AG, 8 BN, 8 BP, 8 BRG, 8 CA, 8 CN, 8 DA, 8 DD, 8 ÉM, 8 ÉU, 8 ÉP, 8 FI, 8 FS, 8 FU, 8 GL, 8 JBL, 8 LMT, 8 MH, 8 MU, 8 NS, 8 OK, 8 PP, 8 QG, 8 SG, 8 TM, 8 UU, 8 VV, 8 WAL, 8 WL, 8 XH, 8 ZUT.** Swedish: **SMZP, SMZY, SMZZ.** Belgian: **4 GP, 4 QS, 4 RS, 4 ZY, W 2.** Italian: **1 FP, 1 MT, 1 HT.** Swiss: **9 AD.** Dutch: **0 II.** Various: **3 XO, 3 CM, 7 EC, SA 2.** (o—v—o Reinartz.) (Chas. Schneider.)

Worksop, Notts. (from August 17th to September 15th).
French: **8 AQ, 8 BD, 8 BF, 8 BO, 8 BV, 8 BRQ, 8 CM, 8 CN, 8 CO, 8 DA, 8 DS, 8 ÉO, 8 FH, 8 FM, 8 FSF, 8 FG, 8 KK, 8 ML, 8 MN, 8 NE, 8 NO, 8 OK, 8 PD, 8 PP, 8 QQ, 8 RG, 8 RR, 8 RCR, 8 SR, 8 SM, 8 UU, 8 WAL, 8 XA, 8 WC, 8 XH, 8 ZM, 8 ZUT.** Belgian: **B 7, 4 C 2, 4 QS, 4 RS, P 1, W 2.** Danish: **7 EC, 7 ZM.** Dutch: **0 GC, 0 MS, 0 RM, 0 ZZ.** Italian: **1 FP, 1 MT.** Swedish: **SMZY.** Various: **3 AD, 3 XO, ICS, GB** (o—v—1.) (I. Davidson.)

Strechford, Birmingham (September 17th to October 19th).
French: **8 BN, 8 BV, 8 CA, 8 CM, 8 CT, 8 DO, 8 DP, 8 DS, 8 ÉN, 8 FI, 8 FS, 8 FM, 8 KG, 8 MU, 8 PP, 8 QJ, 8 RG, 8 RM, 8 SG, 8 SR, 8 VE, 8 VV, 8 WL, 8 WZ, 8 XG, 8 XH, 8 ZM.** Belgian: **4 ALS, 4 GP, 4 RS, 4 UU.** Danish: **7 EC.** Dutch: **OLO, OMST.** Italian: **1 MT, 1 DO.** Swedish: **STTE.** Various: **P 1, IOZ.** (o—v—1, Flewelling and one L.F.) (C. W. Wheeler.)

Weston-Super-Mare (September 15th and October 13th, all below 200 metres).
French: **8 AB, 8 BF, 8 BN, 8 BRW(?), 8 BP, 8 CA, 8 CM, 8 CN, 8 CZ, 8 DA, 8 DI, 8 DP, 8 ÉM, 8 ÉP, 8 ÉU, 8 ÉX, 8 FI, 8 FVQ, 8 GI, 8 JHL, 8 KBR(?), 8 LMT, 8 PA, 8 PD, 8 PP, 8 RBR, 8 RG, 8 SR, 8 SS, 8 UU, 8 VV, 8 WK, 8 WL, 8 XH, 8 ZH, 8 ZM, 8 ZUT, 8 ZZ.** Dutch: **OBA, 0 BJ, 0 II, 0 LO, 0 MV, 0 OX, 0 TR, 0 XF, 0 XP.** Belgian: **W 2, 4 RS.** American: **1 CMP, 1 KC, 1 SZJ, 1 XAV.** Various: **4 YZ, 1 OKZ, 9 AD, 3 CA, 4 QEE, EUEU, PQ, 5 IEH, IDO, ÉIER, U 1 CO, 1 TT, XXDD, A 4 FE, 15 T.** (o—v—1.) (A. H. Giles.)

Weybridge (September 23rd to October 13th, on 150 to 210 metres).
French: **8 BN, 8 CA, 8 CT, 8 DD, 8 DP, 8 ÉU, 8 FV, 8 JH, 8 PF, 8 PJ, 8 PP, 8 RD, 8 RW, 8 UU, 8 UC, 8 WA, 8 ZS.** Dutch: **0 BA, 0 BN.** Various: **4 YZ, 9 AD, JOCD.** (o—v—1.) (Ronald J. Denny.)

Pirbright, Surrey (September 17th to October 15th).
French: **8 AG, 8 AL, 8 BA, 8 BC, 8 BF, 8 BN, 8 BP, 8 BR, 8 CM, 8 CN, 8 CZ, 8 DD, 8 DI, 8 DP, 8 ÉÉ, 8 EP, 8 EU, 8 FI, 8 FS, 8 FU, 8 GD, 8 GL, 8 GR, 8 HSM, 8 LMT, 8 MN, 8 MU, 8 MW, 8 OK, 8 PA, 8 PD, 8 PP, 8 QG, 8 RA, 8 RBR, 8 RG, 8 RM, 8 RN, 8 RR, 8 RZ, 8 SL, 8 SM, 8 SQ, 8 SS, 8 TM, 8 UU, 8 WL, 8 WM, 8 WZ, 8 YG, 8 ZM.** Dutch: **0 BA, 0 FN, 0 II, 0 MS, 0 TB, 0 ZP.** Swedish: **SMZS.** Various: **7 PG, 7 PH, 1 NT, 3 AF, 3 CA, 4 QO, 4 QZ, 9 AD, 1 DO, NBFN 2, P 1.** (o—v—1 Reinartz.) (E. H. Robinson, **5 YM.**)

Cambridge (September 15th to October 10th).
French: **8 CG, 8 DQ 1, 8 DS, 8 ÉP, 8 GI, 8 GK, 8 FD, 8 RM, 8 SG, 8 UUZ, 8 VV, 8 XH, 8 ZST.** Dutch: **0 BU, 0 II, 0 MD.** American: **2 AN, 1 AAC, 1 XAJ, 1 XAV.** Swedish: **SMZY, SMZZ.** Finnish: **2 NM.** Belgian: **I 02.** Swiss: **9 AD.** Various **1 OKZ, YABO, 1 HT, 1 HU, 4 AA.** (o—v—1.) (G. W. Thomas, **2 AQK.**)

Chatham (September 5th to October 7th).
French: **8 AP, 8 BC, 8 BV, 8 BW, 8 CA, 8 DG, 8 DI, 8 DP, 8 FJ, 8 FY, 8 GI, 8 IP, 8 JH, 8 LM, 8 MK, 8 OK, 8 PM, 8 PP, 8 RM, 8 RR, 8 SM, 8 UU, 8 VJ, 8 WE, 8 WI, 8 WK, 8 XH, 8 ZI, 8 ZM, 8 RBR.** Dutch: **0 AB, 0 AG, 0 GC, 0 PG, 0 RM.** Swedish: **SMZV.** Danish: **7 EC.** Italian: **1 ER.** Finnish: **1 NA.** American: **2 CN, 8 DA.** (A. Acland.)

Kirby Muxloe, near Leicester (September to October 10th).
French: **8 DS, 8 ÉK, 8 ÉY, 8 PQ, 8 RM, 8 RR, 8 UU, 8 WK, 8 WL, 8 WZ.** Dutch: **0 BN, 0 QW.** Belgian: **U 2, P 1.** Swedish: **SMZY, AGA.** American: **1 AUG, 1 XX, 2 ADJ, 3 OGG, 4 OA.** Various: **4 RS, 4 YZ, 1 OKZ.** (F. H. Tyler.)

Cobham, Surrey (September 11th to October 10th).
French: **8 AL, 8 BF, 8 BG, 8 BN, 8 BP, 8 BV, 8 CO, 8 DA, 8 DD, 8 DI, 8 DP, 8 ÉD, 8 ÉM, 8 ÉP, 8 FC, 8 FI, 8 FVQ, 8 GD, 8 GI, 8 JHL, 8 KBR, 8 KK, 8 LMT, 8 MN, 8 PP, 8 PQ, 8 RB, 8 RBM, 8 RBR, 8 RG, 8 RIL, 8 RM, 8 RO, 8 SR, 8 SSU, 8 UU, 8 VG, 8 WK, 8 XH, 8 ZM.** American: **1 ABT, 1 AE, 1 AGI, 1 AR, 1 BFN, 1 BG, 1 BGN, 1 BGQ, 1 BHN, 1 BQ, 1 BUN, 1 BX, 1 CCX, 1 CDP, 1 CKP, 1 CMP, 1 ER, 1 FDN, 1 II, 1 MTO, 1 QW, 1 RP, 1 SF, 1 SR, 1 SW, 1 TN, 1 XAV, 1 XW, 1 XZ, 1 ZT, 2 AAY, 2 AN, 2 ANA, 2 BG, 2 BGG, 2 BTA, 2 CDG, 2 PD, 2 RR, 2 XQ, 2 BG, 2 CDG, 2 HS, 3 KD, 3 KW(?), 3 UW, 3 VW, 4 MG(?), 4 RR, 4 SA, 8 XS, HCF, NFV, NKF.** Dutch: **0 AA, 0 KN, 0 LO, 0 RE, 0 WN, 0 ZO, P 2.** Belgian: **4 PS, 4 RS, 4 UU, 4 YZ, 4 ZY.** Italian: **IFP, IDO.** Swedish: **SMSV.** Canadian: **1 AR.** Brazilian: **IHT.** Various: **3 AD, 3 CA, 3 XO, P 2 NE, 1 OCZ, CH 5 M, LIYZ, MM, OCDJ, SAZ.** (o—v—1, Reinartz.) (E. J. Martin.)

Louvain, Belgium.
French: **8 BA, 8 BC, 8 BP, 8 BN, 8 CN, 8 DI, 8 DP, 8 ÉM, 8 ÉU, 8 GN, 8 PP, 8 RG, 8 SM, 8 WL, 8 XR.** Belgian: **4 GP, 4 QN, 4 QS, 4 RS, 4 UU, 4 YZ, 4 QZ, 4 ALS, B 7, W 2.** Dutch: **0 GA, 0 GC.** Various: **D 7 EC, 9 AD, ILMT, ILFP, MMOZD, DE, OXE** (o—v—o.) (A. L. Stainier.)

Failsworth, Manchester (September 22nd to October 12th, on 100 to 180 metres).
French: **8 AP, 8 BN, 8 BR, 8 CS, 8 DD, 8 EU, 8 FS, 8 FV, 8 QG, 8 RG, 8 SG, 8 VV, 8 WL.** Italian: **IMT.** Dutch: **OMS.** Swedish: **SMZY.** Various: **FN 2 NCA, FN 2 NM, 3 DAX, 3 NB, 3 XO, 3 ZP, 4 QS, 4 RS.** (J. Barnes.)

Blackheath, London (September to October).
French: **8 BA, 8 BN, 8 CM, 8 CZ, 8 DA, 8 DP, 8 EK, 8 EM, 8 ÉU, 8 MN, 8 PP, 8 RO, 8 SR, 8 ZZ, 3 CA.** Belgian: **W 2, P 2, 4 OEEE.** Dutch: **0 BA, OII, OYN, 0 MS.** Danish: **7 EC.** Finnish: **1 NA, 2 NM, 3 CB.** Italian: **1 ER, IHT.** Swedish: **SMYZ, SMZZ.** Canadian: **1 AR.** American: **1 AJW, 1 ARE, 1 XAV, 1 II, 1 BR, 1 SF, 1 XGO, 2 BRB, 2 GK, 2 MU, 4 SA, 6 XAD, 9 EM.** (o—v—1 Reinartz.) (R. W. H. Bloxam, **5 LS**).

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Radio Society of Great Britain.

A talk on "2LO's Control Room" will be given by Captain P. P. Eckersley, at a meeting of the Transmitter and Relay Section to be held at 6.30 p.m. at the Institution of Electrical Engineers, on Tuesday, November 11th.

An informal meeting of the Society will be held at 6 p.m. at the Institution of Electrical Engineers on Wednesday, November 12th, when Mr. R. C. Clinker will demonstrate a dynamical model of an oscillating valve circuit.

HIGH TENSION CONDENSERS.

To those accustomed to the use of the small mica fixed condensers found in every receiving set, it requires some stretch of the imagination to picture a mica condenser weighing three tons. Such a condenser was illustrated on the screen by Mr. Philip R. Coursey, B.Sc., lecturing on "High Tension Condensers," before the Transmitter and Relay Section of the Society on October 24th.

In emphasising the increased importance of the high tension condenser since the days of spark transmission, Mr. Coursey illustrated a simple valve transmitting circuit in which at least five condensers were required. This number rapidly grew as the circuit was enlarged. The air dielectric condenser was excellent for certain purposes, said the speaker, but as its capacity increased so did its bulkiness. A way out of the difficulty was provided by the use of mica as a dielectric.

After a number of interesting slides had been shown depicting mica condensers in course of manufacture, the lecturer gave some instructive details of the methods of measuring capacities and voltage stresses. Most difficult of all is the measurement of the power factor, or the energy lost under working conditions. No really satisfactory system has been evolved, but at present more or less accurate results can be obtained by placing the condenser in a closed space of even temperature and submitting it to H.F. currents. Results are obtained by measuring the consequent increase in temperature over a number of hours.

Some confusion may have arisen through a typographical error which occurred in the Society's October letter to members. In the 6th line of the second paragraph, the word "Council's" should have read "Counsel's," thus substantially altering the meaning of the sentence.

Mr. H. Bishop, Assistant Chief Engineer of the B.B.C., lectured before the Stoke-on-Trent Wireless and Experimental Society on October 16th, taking as his title, "The Broadcasting Company and the Difficulties it has been up against."

After a brief outline of the Company's history, Mr. Bishop surveyed the present position, mentioning that about 21 broadcasting and relay stations were now in operation. An entertaining talk followed on the broadcasting methods in the studio and at the transmitting apparatus, and details were given of simultaneous broadcasting arrangements.

In conclusion the lecturer expressed the hope that broadcasting would soon be a necessity in every home.

* * * *

With the opening of its winter session, the West London Wireless and Experimental Association transferred its headquarters to the Belmont Road Schools, Chiswick. Among the subjects recently dealt with at the meetings have been "Aerial and Earth Arrangements," "Telephone Receivers," "Woodwork and Finishing," and "Ebonite Polishing."

A number of interesting lectures are to be delivered in the near future and intending members should enrol without delay.

* * * *

At least a dozen members of the Manchester and District Radio Transmitter's Society are taking part in the Transocean Tests.

On October 7th Professor E. W. Marchant, of Liverpool University, delivered an illustrated lecture on "The History of Radio Transmission," in which he described all the earlier methods and finally proceeded to valve operation.

An attractive syllabus has been prepared and all transmitters in the Manchester area are urged to strengthen the membership.

* * * *

The winter session of the Radio Society of Highgate opened on October 7th, when Mr. P. R. Coursey delivered a Presidential address. Taking as his subject the fascinating and little-explored question of short wavelengths, Mr. Coursey dealt with the design of transmitting and receiving apparatus for this class of work, and suggested some interesting lines of research.

* * * *

The City of Belfast Y.M.C.A. Radio Club opened the session on October 14th with an instructive

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lecture delivered by Major Rupert Stanley, LL.D., M.I.E.E., who spoke on "The Electron Theory and the Fundamental Principles of Valve Action."

Having sketched the history of ether signalling by light waves through the ages, Major Stanley recounted man's efforts to create longer ether waves, and having created them, to detect them. In explaining the electron theory, he remarked that it was interesting to note that this theory was first propounded by Professor Storey in Belfast, in 1874. The lecture concluded with some useful hints on the construction of receivers.

* * * *

The Sunderland Wireless and Scientific Association opened the new session on October 11th, when the retiring President, Dr. Wilcken, introduced his successor, Mr. E. Jeffrey, B.Sc., L.C.P.

In his inaugural address Mr. Jeffrey dealt interestingly with "Scientific Ideals."

The Association is applying for a transmitting licence, for the purpose of investigating fading by means of a portable receiver working with the transmitter over the surrounding country. New members are warmly welcomed and applications for membership should be addressed to the Hon. Secretary, c/o the Editor of *The Wireless World and Radio Review.*

A CORRECTION.

A slight error occurred in the advertisement of the Wireless Diary, appearing on page xxxii of our issue of October 29th. The price of the Diary in leather case, containing three pockets, season ticket window and pencil, is 2s. 6d.; cloth bound, 1s., and not as stated.

WIRELESS EXHIBITION AT MAIDSTONE.

Maidstone's Second Annual Wireless Exhibition is to be held in the Concert Hall, Corn Exchange, from November 11th to 15th, the opening ceremony being performed by G. Foster Clark, Esq., J.P. Organised by the Maidstone and District Radio Society, the Exhibition promises to be quite as successful as last year's event. Interesting competitions have been arranged and prizes will be awarded for the best home-constructed crystal, one, two, and three-valve sets. An imposing display of apparatus and accessories is promised by the leading wireless firms of Maidstone and an attractive feature of the Exhibition will be a wireless dance, to be held on Saturday, November 15th, from 10 p.m. till 12 midnight. At 7.30 on the same evening, Mr. H. Bishop (Assistant Chief Engineer of the B.B.C.) will give a talk on the work of the Broadcasting Company.

AN INDISPENSABLE ITEM.

Many an amateur, hearing an unknown call sign, worried by the questions of a novice, or perhaps involved in a tiresome argument, must have felt the urgent need of "finger tip" information, which would enable him to settle the matter "once and for all."

There is an abundance of this class of information to be found in the pages of "The Wireless Amateur's and Experimenter's Diary and Notebook for 1925," which has just been published by The Wireless Press, Ltd., in conjunction with Charles Letts & Co.

The early pages provide for personal memoranda, tunings for receivers and other useful entries. These are followed by illustrated wireless notes and circuits, specially prepared by Mr. W. James, dealing with a graduated variety of the most efficient receiver arrangements in general practice.

One of the most important sections is the comprehensive and up-to-date list of experimental transmission stations, containing many hitherto unpublished call signs, and occupying thirty pages.

The useful data section at the end of the diary provides tables for calculating gauges and turns of wire for coils, recognised formulæ, sizes of tapping and clearance drills for B.A. screws, coils sizes and other invaluable information.

The Diary and Notebook can be obtained from all booksellers, price 2s. 6d. in leather case, with pencil, season ticket window and three pockets, or cloth bound for 1s. It can also be secured direct from the Wireless Press, Ltd., 12-13 Henrietta Street, London, W.C.2., postage 2d. extra.

CORRESPONDENCE.

Oscillating Crystals.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With reference to the researches of Mr. O. Lossev. With the aid of the information he has placed at the disposal of the world, I have recently succeeded in generating good oscillations which have remained constant for hours, and can be started at will, from zincite-steel contacts. Your readers should therefore please consider my remarks about the difficulty of making practical use of crystal oscillations as withdrawn, at least as regards the combination in question.

LESLIE MILLER.

London, S.W.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 5th.

Institution of Electrical Engineers (Wireless Section). At 6 p.m (light refreshments at 5.30). At the Institution, Savoy Place W.C.2. Address by Mr. E. H. Shaughnessy, O.B.E. (Chairman).

Bristol and District Radio Society. Wireless Lecture No. 2. By Mr. W. A. Andrews, B.Sc.

Radio Research Society, Peckham. At 44 Talfourd Road. Lecture: "Relays." Discussion: "Measurement of Signal Strength."

Edinburgh and District Radio Society. At 8 p.m. At 117 George Street. Fourth General Meeting of Series.

THURSDAY, NOVEMBER 6th.

Bournemouth and District Radio and Electrical Society. At 7 p.m. At Canford Hall, St. Peter's Road. Lecture: "Special Forms of Coupling." By Mr. W. H. Peters.

Derby Wireless Club. Informal Discussion.

Luton Wireless Society. At 8 p.m. At Hitchin Road Boys' School. Lecture by Mr. C. C. Atkinson.

Kensington Radio Society. Lecture: "The Working of a Telephone Exchange."

West London Wireless and Experimental Association. At Belmont Road Schools. "Constructional Details. Part II." By Mr J. T. Bruce.

FRIDAY, NOVEMBER 7th.

Bristol and District Radio Society. Social Evening at Comer's Restaurant, High Street.

TUESDAY, NOVEMBER 11th.

Radio Society of Great Britain. Transmitter and Relay Section. At 6.30 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Captain P. P. Eckersley will give a talk on "2 LO's Control Room."

Radio Society of Highgate. At 8 p.m. At the Literary and Scientific Institute, South Grove. "What Valves to Use." By Major W. I. G. Page.

Leicestershire Radio and Scientific Society. At the Y.M.C.A. Lecture by Mr. Albert J. Scholfield, L.D.S. (President).

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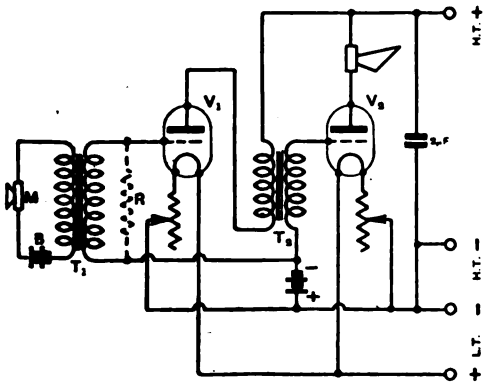
READERS PROBLEMS

Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

A MICROPHONE AMPLIFIER.

WIRELESS experimenters are very often asked to arrange apparatus to amplify speech so that it may be projected from a loud speaker for the purpose of announcements or addressing public meetings.

It is quite a simple matter to arrange the necessary apparatus, and a diagram of the circuit is given below. The microphone (M) and a local battery (B) are connected in series with the primary winding of the special microphone transformer T_1. Microphone transformers are available from many of the principal manufacturers of wireless apparatus, and are constructed with a low resistance primary winding and a high step-up ratio. The intervalve transformer T_2 should be chosen to suit the characteristics of the valve V_1. It would be convenient to use a D.E.5 type valve for V_1 and an L.S.5 for V_2. With these valves a transformer with a ratio of 6 : 1, such as the Marconiphone "Ideal" transformer, could be used with advantage.



An amplifier for microphone currents.

If the loud speaker is connected directly in the plate circuit of the last valve, thicker gauge of wire should be used for the magnet windings. As the impedance of the L.S.5 valve is comparatively low, the loud speaker need not have a resistance above 1,000 ohms. Amplitude distortion may be caused if the microphone current is too high. In the event of distortion taking place the voltage of the battery may be reduced, or a resistance (R) of the order of 0·5 to 1 megohm may be connected across the secondary winding. Incidentally, this resistance will tend to improve the quality of speech, apart from the reduction which it produces in the amplitude of the currents impressed on the grid of the first valve.

FINE ADJUSTMENT FOR REACTION.

ONE method of obtaining a fine control over the reaction coupling is to connect a vernier condenser across the reaction coil. As the value of this condenser is increased the current through the reaction coil is reduced, as the small capacity acts as a shunt to the H.F. currents. If the reaction condenser is provided with an extension handle this method is very satisfactory, provided that the natural wavelength of the reaction coil, in conjunction with the condenser, does not approach that of the signal being received. If possible the natural wavelength of the reaction circuit should be kept below that of the grid circuit of the valve. If the natural wavelength of the reaction circuit is above the wavelength of the signal received, there is always a possibility that during subsequent tuning adjustments the wavelength of the grid circuit will be raised until it equals that of the reaction circuit. When this occurs all control over the reaction is lost. Sometimes oscillation cannot be stopped, and under other conditions the set will not oscillate on one definite wavelength, and a "blind spot" occurs.

Unless one knows exactly the constants of the reaction circuit, it is better to dispense with the vernier condenser, and to employ a vernier adjustment on the coil holder itself.

Readers are referred to an article entitled "Efficient Reaction," by H. Stopher, in the issue of October 29th, 1924.

NOISE IN A NEUTRODYNE RECEIVER.

A READER who has constructed a neutrodyne receiver writes to say that a good deal of noise is experienced, and that it is his opinion that the noise would cease if a crystal detector were substituted for the valve detector.

At the present time receiver noises are very rarely due to faulty valves, and the disturbance is more likely to be due to poor insulation or a run-down H.T. battery. If an excess of soldering flux is used when wiring the panel the fumes are apt to cling to the surface of the ebonite panel and to destroy its insulating properties. Unless the detector valve happens to be the faulty valve in the receiver,

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the substitution of a crystal detector would not in any way affect the amount of extraneous noise and in any case a crystal detector could not be employed in the neutrodyne receiver, as the variation of the resistance of the crystal contact would prevent a perfect balance being obtained.

SWITCHING A THREE-VALVE RECEIVER.

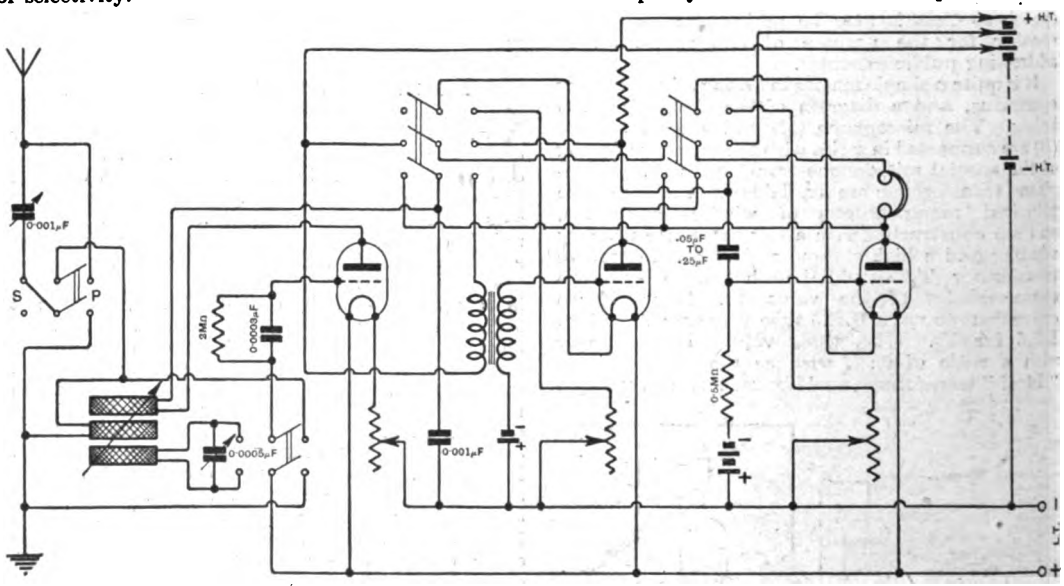
IN the circuit given below two low frequency amplifying valves are employed, the first transformer coupled to the detector valve and the second coupled by means of the resistance capacity method. In a receiver of this type it is essential to provide separate H.T. tappings for each valve, and three pole change-over switches are therefore necessary for switching off the L.F. valves. The circuit is suitable for general reception, and the coupled tuning circuit provides an adequate degree of selectivity.

wire in an aerial of this type would be less than usual, the result obtained would be better, owing to the lower capacity and effective resistance of the aerial. A small weight attached to the aerial wire a few feet from the lead-in prevents rain water from running over the lead-in insulator and reduces swaying.

A STABLE DUAL CIRCUIT.

REFERRING to the article under the above title, in the issue of January 3rd, 1924, a reader asks what value should be given to the fixed condenser connected in the anode circuit of the first valve.

The value of this condenser is not critical, and it may be given a value of approximately 0·0001 μF. This condenser acts as a high frequency by-pass, and its capacity should therefore be kept small.



A three-valve receiver with transformer and resistance-capacity coupling for the L.F. valves.

ROOF AERIALS.

WHEN ground is not available for the erection of a mast at some distance from the house, it becomes necessary to erect an aerial on the roof of the house itself. In erecting this aerial it should be remembered that the effective height will be the height of the aerial wires above the roof of the house, and not above the ground level, and the poles supporting the horizontal portion of the aerial should therefore be raised as far above the roof as possible. In bringing the lead-in down the front of the house spreaders should be arranged to keep the wires as far as possible from the side of the house.

If it is impracticable to use poles on the roof greater than 10 or 15 feet in length, it would probably be better to dispense with the top portion of the aerial, and to use a single wire suspended from a light pole projecting at right angles from the side of the house. Although the length of

VARIABLE CONDENSER PLATES.

THE moving vanes of a variable condenser need not be placed symmetrically between the fixed vanes. The calibration of the condenser will vary, however, if the bearings of the moving vanes are not rigid. In other words, the calibration will vary if the moving vanes are moved longitudinally with respect to the fixed vanes.

RECEPTION ON 10 METRES.

SEVERAL readers have asked us to give designs for receivers to operate on wavelengths of the order of 10 or 15 metres. Special methods have to be employed for these wavelengths, and, in general, ordinary amateur aerials cannot be used. Readers interested in this subject are referred to the issue of this journal for June 30th, 1923.

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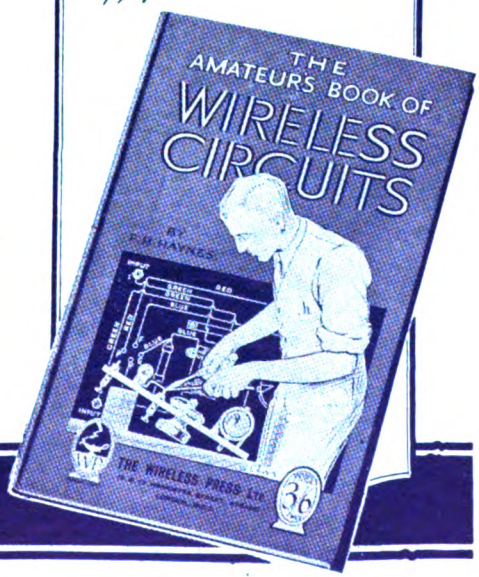

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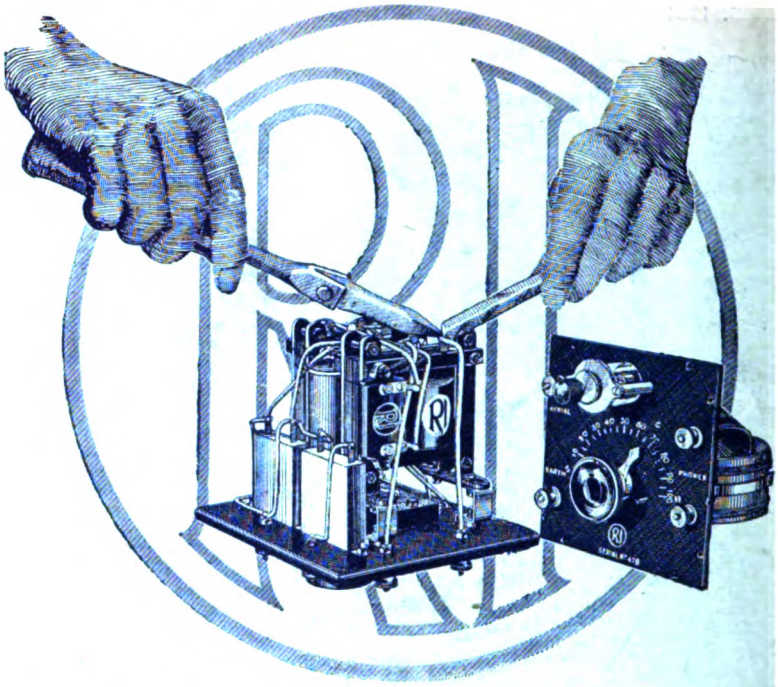

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THE WIRELESS WORLD AND RADIO REVIEW

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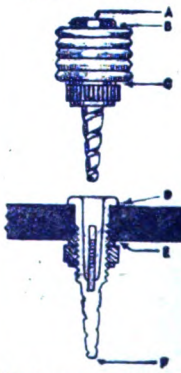

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

THE TRANSATLANTIC BROADCAST TESTS.

IT will be remembered that last year *The Wireless World and Radio Review*, in conjunction with *Radio Broadcast* of America, organised a series of experimental tests of broadcasting between the United States and this country. The British Broadcasting Company kindly co-operated and conducted transmissions to America, whilst on the other side Mr. Lynch, editor of *Radio Broadcast*, had the support of the majority of the American broadcasting organisations in arranging for transmissions to England.

This year, as we have previously announced in *The Wireless World and Radio Review*, a further series of tests will be carried out from November 24th to November 30th inclusive, and although no detailed announcements have appeared recently in the columns of this Journal, the arrangements for the tests have been going forward steadily, and we are now in a position to give further particulars.

The British Broadcasting Company has again this year kindly undertaken to participate and the arrangements have been extended further by inviting broadcasting stations on the Continent to come in and join in the transmissions to America. As a consequence stations in almost every country in Europe will participate.

The interest which has been aroused in America and Canada over these transmissions is enormous, and so complete has been the response to the invitation made by *Radio Broadcast* that American broadcasting stations should co-operate that it has been possible to carry out arrangements whereby practically all American broadcast stations, and some others in addition, have undertaken to keep silence during the hours when the European stations are transmitting.

Of course, it will be realised that the interest in America in these tests is likely to be greater than on our side for the reason that the ordinary hours of evening programmes of European broadcasting stations correspond to hours of daylight in America and the conditions are therefore so unfavourable to reception of the European stations that we understand it has not been possible for Americans to listen in at all to our programmes. By arranging for the European transmissions to take place in the early hours of the morning we have got over this disadvantage and the hour of silence when America will listen for Europe will be during or immediately following their usual broadcast programme hours.

In order to give Europe a special opportunity for listening to America, endeavour has been made to ensure as much quiet on this side as possible whilst the American and Canadian stations are conducting transmissions. These transmissions will be specially intended for European listeners and wherever possible increased power will be used by the transmitters. In addition to special musical programmes, various speeches will be made.

The American transmissions will take place from 3 a.m. to 4 a.m. G.M.T. each morning from November 24th to 30th inclusive. European transmissions will follow immediately from 4 a.m. to 5 a.m. and these will be by the stations of the British Broadcasting Company, including **5 XX** on the mornings of the 25th, 27th and 30th November, whilst Continental Stations will transmit as a unit from 4 to 5 a.m. G.M.T. on the

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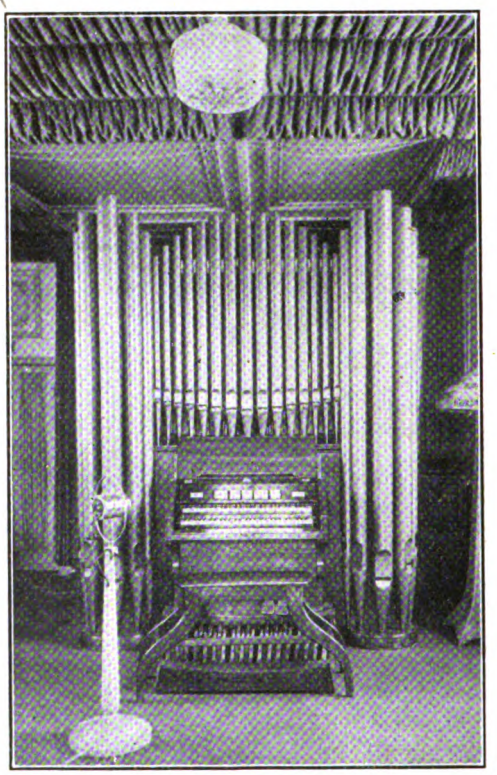
mornings of the 24th, 26th, 28th and 29th. All stations participating in the transmissions will give indications of their identity at frequent intervals in their transmissions, in order that the American listeners may be quite sure what stations they are receiving.

The four Parisian broadcasting stations will all participate in the tests, and among the other Continental stations also engaged will be those at Madrid, Brussels and Rome, and the German stations at Berlin (Vox Haus), Hamburg, and Koenigswusterhausen.

The organisation of the Canadian broadcasting stations in the international tests is in the hands of Mr. J. N. Cartier, who is the manager of the station **CKAC** owned by *La Presse*, Montreal. A view of the studio of this station appears on this page, and it will be seen to possess several novel features, and attention might be drawn to the novel method of controlling the extent of damping. The draping over the ceiling is removable, giving control of sound absorption and echo.



The organ in the studio of the well-known Canadian Broadcasting Station **CKAC**, *owned by "La Presse," Montreal. Note the curtains above, which can be drawn aside to lessen the damping effect. Operating on* 425 *metres, this station will take part in the International Broadcasting Tests during the last week of November.*

In America the tests provide unique opportunities for finding the extent of the range of receivers. Captain Eckersley, when he broadcast from **2 LO** the other evening an account of his visit to America, told us that the American listener attaches more importance to the selectivity and range-covering properties of his receiver than to its efficiency as a reproducer of good quality music and speech, so that the American will have a special interest in these tests. Captain Eckersley has taken a keen interest in these arrangements and on his visit to America recently he met Mr. Arthur Lynch, Editor of *Radio Broadcast*, and had the opportunity of discussing the details for the tests.

Since last year's tests a marked improvement has been made in the design of American receiving equipment. For instance, it was not until quite recently that the use of neutrodyned receivers came into general use, and the present extensive adoption of this type of set, with efficient amplification at high frequency, is likely to give rise to good reception of the European signals on a considerable scale. The supersonic heterodyne arrangement has also developed in the hands of the American public, and outfits of this class are in fairly general use.

The interest in America has not been confined to the United States alone, for Canada, Cuba and Porto Rico and other countries are also taking an equal interest in the arrangements.

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SELECTIVE RECEIVING CIRCUITS.

The conditions are reviewed in this article by which energy is set up and transferred in the tuning system of a receiver. The conclusions are of considerable importance in receiver design.

By N. W. McLACHLAN. D.Sc., M.I.E.E.

MODES OF ENERGY TRANSFER BETWEEN COMPONENTS.

EVERYONE is familiar with capacity effects in a receiver, the simplest of which is probably the so-called self capacities of the various coils. There are also the capacities of the different components to earth, thus enabling reception without a direct earth connection, and the capacities between adjacent coils. In treating the problem of coupled circuits mathematically, capacity effects are generally ignored—excepting, perhaps, the self capacities of the coils—and the transfer of energy from one circuit to another is regarded as being due to electromagnetic induction. We know, however, from practical experience, that this assumption is only approximately true even after great care has been taken in the design of a receiver, so that the capacity and other effects have been reduced to a minimum. A straightforward high frequency multi-unit circuit is illustrated in Fig. 1, and consists of an aerial A, coupled to the tuned circuits A_1, A_2, A_3. If the assemblage functioned according to the simple mathematical hypothesis, the energy collected by the aerial would be transferred—with, of course, the usual inter-circuital transmission losses—by electromagnetic coupling to A_1, thence to A_2 and A_3. But we know that there are other modes of energy transfer between the various components and from the incoming electric waves. These are summarised below:

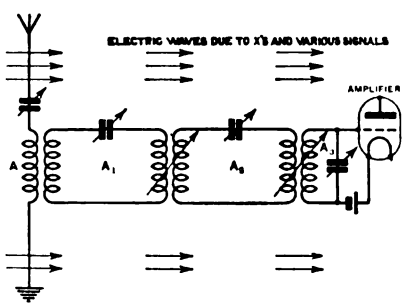

Fig. 1. The three stages of coupling produce an energy transference, accompanied by improved selectivity. The intermediate tuned circuits also act as collectors of energy and in consequence the property of extreme selectivity may be lost.

(1) Electromagnetic coupling between any two components. This, of course, can be reduced to a minimum by arranging the various coils with their axes in planes mutually at 90 degs. to each other. Since there are only three planes mutually at 90 degs., this arrangement will only work with three circuits.

(2) Each coil acts as a frame aerial, and the incoming electric radiation from the distant transmitter yields currents in the circuits which are superposed on those induced from the aerial *via* the coupling coils. There is, of course, the exceptional case when a coil is oriented with its axis parallel or vertical with reference to the direction of propagation of the resultant electric field—assumed to be non-rotational—in the neighbourhood.

(3) Condenser effect between *any* two circuits or between a circuit and earth.

In order that the coupled circuits of Fig. 1 shall operate most effectively, it is imperative to avoid the three extra sources of energy transfer to the fullest extent. The reason why these additional modes of energy transfer to the receiving circuit are undesirable is as follows. The purpose of any tuned aerial circuit is to collect as much as possible of the desirable energy from the incoming radiation, and to reject as much as possible of the radiation due to extraneous causes, *e.g.*, atmospherics and jamming stations. Moreover, the tuned aerial circuit

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is a selective device, and its dead loss or wasteful resistance should be as low as possible. Having partially purged the radiation "mixture" in the neighbourhood of the aerial by the aid of a selective circuit, we shall assume the strength of the current due to the desired signal to have a certain relationship to currents due to other sources. When a closed tuned circuit such as A_1 in Fig. 1 is loosely coupled to the aerial, the ratio of the signal current to currents in A_1 from other sources will be greater than that in the aerial A. If, however, circuit A_1 is not protected from the incoming radiation, currents of other frequencies will be induced in it in addition to those induced from the aerial. The ratio of these alien currents to the signal current will depend on the degree of selectivity of this circuit A_1. Thus although part of the energy transferred from A to A_1 is filtered to reduce the relative intensity of atmospherics, etc., there is a certain amount of energy penetrating the circuit directly, which is not filtered by A. Thus the ratio of signal current to alien currents is reduced, due to direct energy supply to A_1 from the incoming waves. A similar argument applies to coils A_2 and A_3. In the case of coil A_3, matters are much worse. The filtering which occurs in the normal way, due to the inductive couplings AA_1, A_1A_2, A_2A_3 reduces the signal strength to a very small value. Thus the alien currents—especially those caused by comparatively high voltage atmospherics, or by a powerful near-by transmitter—arising from A_3 acting as a frame aerial or otherwise—may be large compared with the filtered signal current which reaches A_3 in the orthodox manner. Hence if the various tuned circuits are left unprotected from extraneous radiation, their efficacy as filtering arrangements is impaired.

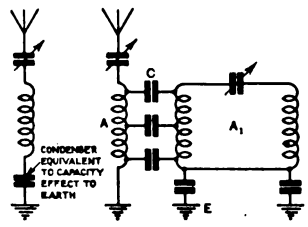

Fig. 2. *Fig. 3.*

Fig. 2. The apparatus composing the tuned aerial circuit serves as a collector by virtue of its capacity to earth.

Fig. 3. The capacity C, presented between the circuits A and A_1 gives rise to energy transference owing to the potential differences existing between the two coils.

CONDENSER ACTION BETWEEN COMPONENTS.

The next aspect of the subject is one which merits attention. In viewing the action of an aerial from a physical standpoint, the simplest way is to consider the earth to be one plate of a condenser and the aerial wire the other. This condenser and the loading inductance constitutes an oscillatory circuit. When the current is oscillating in the aerial, the earthed end is substantially at a constant potential, but there is a difference in potential between earth and any point on the aerial. If an alternating difference in potential exists between two parts of the same or different electric circuits, there is a condenser action brought into play. That is to say, there is a capacity effect between the two portions of the circuit, which causes a current to flow. Consider now an aerial whose circuit is similar to that of A in Fig. 1, but whose lower end is not earthed. This will receive signals and a current will flow, but the intensity will be small compared with that when the lower end is earthed. The reason why an unearthed aerial constitutes an oscillatory circuit is simply that the loading coil and the aerial have a capacity to earth, *i.e.*, the coil represents one plate of a condenser and the earth the other. There is also the action of the assemblage as an isolated oscillator (see below). The strength of the received signals is most marked on short wavelengths. The effect is somewhat similar to that when a small shortening condenser is placed between the loading coil and earth, and may be designated "antenna" action. The equivalent circuit is illustrated in Fig. 2. There is a supplementary action due to the loading coil acting as a frame aerial (mistuned.)

These latter actions are really particular cases of the general effect of electric waves on any suitably situated conductor. An electric wave is concomitant with a potential gradient in space. Since the gradient is of an oscillatory nature, currents are induced in any conductor situated in the electric field, so that a potential exists between two points on it. When the conductor is suitably dimensioned electrically (inductance and capacity), the response to the incoming waves is a maximum. For example, if a uniform straight wire of the proper length,

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about half a wavelength, is well away from earth and suitably situated in the path of an electric wave, the frequency of the natural oscillation on the wire is equal to that of the electric wave. In this case, both ends of the wire are free, and the maximum current (antinode) occurs at the centre of length of the wire.

We have already indicated that an alternating difference in potential between two parts of an electric circuit involves condenser action. The next step is to apply this principle to the receiving circuit illustrated in Fig. 1. Suppose we devote our attention to the aerial tuning inductance first. During reception there is a difference of potential between its ends. This is due to two main factors: (*a*) potential drop due to the current flowing in an inductive circuit; (*b*) potential drop due to loss incurred by current flowing in the coil. The loss is chiefly caused by the eddy currents induced in the wire due to the oscillatory current, and to the effect of the oscillatory voltages on the insulation between the neighbouring turns. The latter source is dielectric loss. Now the potential difference gradually increases from one end of the coil to the other, so that every part of the coil is at a different potential from the lower end. Thus there is the well-known condenser action between adjacent turns of the coil, and this is cumulative throughout its length. Since the aerial tuning inductance does not behave solely as such, but has condensive attributes also, we are led to ask what effect the latter have upon reception. If the received wavelength is much longer than the natural wavelength of the coil, *i.e.*, the aerial capacity is much greater than that of the coil, the condenser effect due to self-capacity can be disregarded.* Put in another way, the natural frequency of the coil must be much higher than the frequency of the incoming signals. This means that the capacitive impedance of the coil is much greater than its inductive impedance. As the frequency is increased the inductive impedance is so large that most of the current is bye-passed due to condenser action.

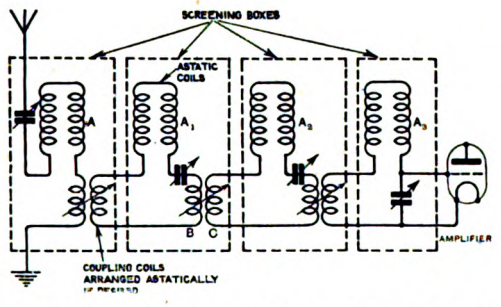

Fig. 4. To minimise capacity coupling, only a portion of the coils between which a low potential difference exists is shown coupled.

Taking now the coupling which exists between the coils A and A_1 of Fig. 1. The adjacent parts of these coils during reception will be at different potentials owing to the currents in the two circuits. Thus there will be condenser action and energy will be supplied from circuit A to circuit A_1 just as though the two were connected by a condenser. An approximately equivalent circuit is shown in Fig. 3. Owing to the capacity effect of coil A_1 to earth, there is a complete circuit formed, viz., ACA_1E. The condenser current which flows between A and A_1, A_1 and earth, traverses the windings of A and A_1. If C is the capacity of a condenser, V the difference of potential between its terminals and n the frequency, then the condenser current which flows is $I = 2\pi nCV$. Thus the current increases with increase in (*a*) frequency; (*b*) capacity; (*c*) voltage or potential difference. From (*a*) we see that with given coils the condenser effect is most conspicuous on short waves. A good example of condenser effect is that between two adjacent aerials. The capacity coupling is large owing to the geometrical configuration of the structures allowing a copious interlinkage of *electric* strain lines. In practice the only item likely to be fixed is the frequency. Thus to minimise condenser effect at a given frequency, it is essential to reduce the capacity and also the difference in alternating potential which exists between adjacent parts of the circuit as much as possible. So far as capacity between adjacent coils is involved, it is the best policy to avoid using the main portion of the coil for coupling purposes. Coupling can be obtained most conveniently by small auxiliary coils in series with the main coils. This is illustrated diagrammatically in Fig. 4, the auxiliary

* A fly-wheel circuit is not considered here.

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coils being B and C. Although we have illustrated the use of two small coupling coils in Fig. 4, quite satisfactory results can be obtained with only one coil, *e.g.*, B, this being coupled to the main coil of the next circuit, thus dispensing with coil C. The reduction of potential difference effects is best obtained when all the coupling coils are kept as near to earth potential as practicable. Thus in Fig. 4 the aerial coupling coil is situated next to earth. The complete aerial system as shown roughly in Fig. 1 has been rearranged in Fig. 4. The result of the rearrangement as exhibited in Fig. 4 is to reduce very appreciably (1) direct reception of electric space waves by any portion of the circuit except the aerial; (2) electromagnetic interaction between the units of the receiver, excepting that which exists in virtue of the inter-coupling coils; (3) condenser action between the units of the receiver.

It is of interest to compare the tuning properties of the circuits in Figs. 1 and 4. Suppose all the circuits of Fig. 1 are accurately tuned to the incoming signals; then let the condenser in circuit A_2 be varied. As we pass away from the tune point, the signals will fade fairly rapidly at first, but as we get farther from this point, there is little variation in the signal strength. Thus there is a " residue " which is due to energy penetrating the system in the unorthodox ways which have been quoted above. Let us turn now to an arrangement constituted on the lines of Fig. 4. Assuming all the circuits to be at their resonance or tuning points, again vary condenser in circuit A_2. The signals will fade very rapidly at first, and will gradually die away to inaudibility as the condenser is moved farther away from the tuning point. This clearly shows the advantages and the absolute necessity for designing a receiving circuit to function in a proper manner.

In addition to the use of metal screening boxes to enhance selectivity, we ought to mention that the coils must be sufficiently far away from the faces, especially if the boxes are constructed of iron, so that the action now familiarly known as " spade tuning " is avoided.

In low decrement filter circuits it is of paramount importance that all the units should be accurately tuned to the incoming signal. A departure from this rule means that when the signal arrives, it impulses the untuned unit and creates oscillations of two different frequencies; (1) the forced oscillation having the same frequency as the signal; (2) the free oscillation having the frequency of the mistuned circuit. The effect of these two oscillations obtained from the arrival of morse signals of suitable speed can be studied by the aid of reaction. When the decrement of the circuit is low enough, two beat notes are audible in the telephones, one corresponding to the *free* and the other to the *forced* oscillation. With strong atmospherics the influence of mistuning a low decrement circuit is to receive the atmospherics, but to exclude the signal. This is due to the fact that the strength of the atmospheric in the tuned circuit is almost the same for all tune points within a narrow zone on either side of the signal frequency, whereas for *optimum signal* strength accurate tuning is imperative.

ASTATIC COILS.

There is an auxiliary artifice worthy of mention, and which is often of great value whether screening boxes are available or not. The arrangement about to be outlined assists in the annulment of (1) electromagnetic effects between the components of a receiving circuit; (2) frame aerial effect due to incoming radiation acting directly on the coils.

In the early days of galvanometer construction, the late Lord Kelvin invented the arrangement known as an astatic couple. This consisted of two parallel bar magnets suspended one above the other with unlike poles adjacent, *i.e.*, the north pole of one was immediately above the south pole of the other, and *vice versa*. The arrangement was independent of the earth's magnetic field, and did not point north and south, as one of the magnets would have done if suspended by itself. In more general language, the system was free from the influence of uniform external magnetic fields. Now this principle of astaticism can be applied with success in the design of radio receivers, to protect the circuits from the influence of uniform oscillatory electromagnetic fields.

If two identical coils of wire arranged with their axes parallel and at right angles to the plane of the paper, are situated in a uniform alternating or pulsating electro-

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magnetic field, the electromotive force induced in each will have the same value. The e.m.f. will be alternately positive and negative at the near ends of the coils. Imagine that it is positive; then the far ends will both be negative. Thus if the far ends of the coils are united, the potential difference so far as electromagnetic effects are involved, between the near ends will be zero (see Fig. 5). This is due to the fact that the voltages induced in the two coils are equal but opposite. Moreover, the arrangement is astatic in the *electromagnetic sense*, and is, therefore, free from the disturbing influence of a *uniform* alternating magnetic field. We may now pass on to consider the effect of a non-uniform pulsating field on the above arrangement. It is clear that if the field is stronger in one coil than it is in the other, the voltages induced in the two coils will no longer be equal and opposite. Thus the arrangement will cease to function astatically. For example, suppose a coupling inductance coil from an adjacent valve oscillator is brought near the end of one of the pair of coils—let it be placed co-axial with it. The e.m.f. induced in this coil will be much greater that than in the other. If, however, the coupling coil were arranged symmetrically with regard to the astatic pair, but not sufficiently near to introduce appreciable electrostatic coupling effects, the resultant e.m.f. induced in the pair would be zero. In practice, when coupling together two unscreened adjacent astatic units electromagnetically—in this case the circuits would be completed by the usual tuning condensers—the coupling coils themselves, which form part of the circuit, must also be arranged astatically. Thus a separate coupling coil is used for each unit of an astatic pair, as indicated in Fig. 6.

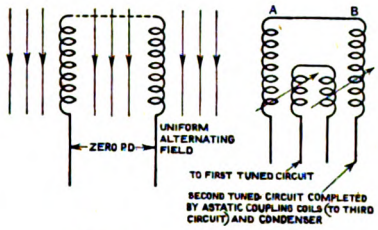

Fig. 5.

Fig. 6.

An astatically arranged tuning coil (Fig. 5), and an astatically arranged coupled circuit (Fig. 6).

When circuits are arranged in this manner, and also effectively screened from the electric and magnetic components of the incoming radiation by metal boxes, there is little fear of mutual electromagnetic interaction between them, apart from the orthodox amount introduced by the coupling coils. Also the effect of external magnetic fields is reduced to a considerable degree. The principle of astaticism can, of course, be applied to low frequency circuits with either air or iron-cored coils. In unscreened note filters, it is useful in avoiding reaction due to magnetic coupling.

In general, it is advisable to connect all screening boxes to a good earth. It should be borne in mind that—so far as signal strength is concerned—two distant points on a common earth connector may have an appreciable potential difference between them, due to the current in the wire, arising from its acting as a leak to earth and as a mistuned aerial, as explained above in the section on "Condenser Action." Also it is sound policy to connect the negative poles of both high and low tension batteries to earth. The employment of carefully designed screens is gradually growing as the radio art progresses. but they ought to be used more frequently than is usual at present.

WIRELESS WANTED FOR CHANNEL ISLES.

Strange as it may seem, there is no wireless installation in any of the Channel Islands, despite the dangerous nature of the surrounding coasts. Thus a distress message sent out from the Casquets or Corbieres can reach neither Guernsey nor Jersey except through England, whence it is transmitted by cable. Moreover, on Sunday the post offices are closed after 10 a.m., and telegrams are not delivered.

To remedy this serious state of affairs, the Jersey States passed a resolution last December to the effect that a wireless installation be erected forthwith on the most suitable spot. This was referred to the State's Piers and Harbours Committee for execution, but up to the present nothing has been done.

In view of the ever-present dangers to navigation, such a situation is deplorable and the Piers and Harbours Committee would be well advised to proceed with the work at once, before the winter storms set in.

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AN EASILY MADE THREE-COIL HOLDER

By G. H. P. GIBBS.

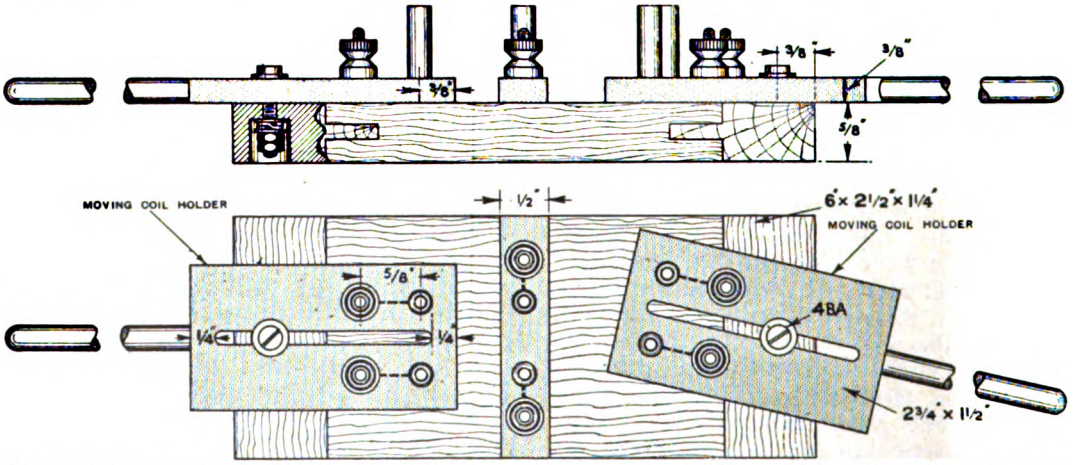
THIS coil holder was the result of an attempt to construct a simple and inexpensive coil holder which would permit of fine coupling adjustments. As may be seen from Fig. 1, the three-coil holder consists of a base carrying a fixed holder and two movable holders.

The base is of hard wood measuring 6 ins. by 2½ ins. by ⅝ in. In the centre of the base is mounted the fixed holder, consisting of an ebonite strip, 2½ ins. by ½ in. by ⅜ in., which carries two valve sockets. These sockets are ¾ in. apart, and are each connected to a terminal by a wire run between them in a groove cut in the under side of the ebonite.

Examination of the figure will reveal the method of mounting the moving coil holders.

The base of the holders have a slot of width sufficient to clear a 4 B.A. screw. An easy way to make the slots is by drilling a number of holes, and then removing the surplus material by filing. Be sure not to make the slots too wide—they should just clear a 4 B.A. screw.

A 4 B.A. screw is mounted in each part of the base to operate as a pivot for the movable coils. It is necessary to employ a large washer between the head of the screws and the upper surface of the holders, and to place a spring washer between the



Details for constructing a simple three-coil holder. Adjustment of coupling is obtained by rotating as well as by increasing the distance between the coils.

Each moving coil holder comprises a piece of ebonite, 2¾ ins. by 1½ ins. by ⅜ in., which carries at one end the sockets for the coil and the terminals for the connecting wires. The sockets are ¾ in. apart and mounted ⅜ in. from the end of the strip. It is necessary to drill and tap the ebonite strip to take the screwed ends of the sockets and terminals, and care must be taken when cutting the threads. Connection between the sockets and terminals is made by a length of wire run in a groove cut in the under side of the ebonite.

nuts and the base on the under side of the base. The figure shows the details quite clearly.

Handles for moving the coil holders may consist of lengths of strip wood or ebonite, screwed to the holders.

The spacing of the sockets of the holders given above are correct for most types of basket-coil holders. Those who use ordinary plug-in type coils will find it an easy matter to fix panel mounting type holders instead of the valve sockets.

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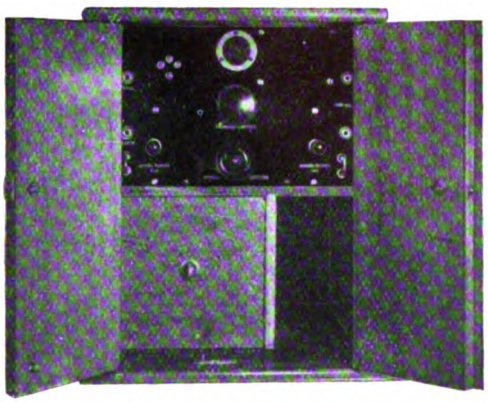
SINGLE VALVE REFLEX CABINET SET.



A front view of the receiver.

By R. H. COOK.

NOT only is the external design of the receiving set governed by the purpose for which it is required, but the circuit and the tuning system also must be carefully considered. The receiver to be described here has been designed for the use of the non-technical listener, for it so often falls to the lot of the wireless amateur to construct a set for the use of his wireless friends to whom the science of wireless makes little appeal.

This receiver is not a loud speaker outfit and is better described as a simple set, easy and inexpensive to build and requiring a minimum of filament current.

Reference to the circuit diagram, Fig. 1, will show the receiver to consist of an aerial tuning inductance which is not variable as to the number of turns, but is tuned by means of the inductance change brought about when a copper cylinder slides over the winding. The tuned plate circuit of the valve which provides the necessary amplification at high frequency is tuned in a like manner, while in both aerial and anode circuits connectors are introduced for the insertion of loading coils, when it is desired to extend the wavelength range for the reception of the high power and continental broadcasting stations. A crystal detector is employed and the rectified signals fed back into the grid circuit, while the telephone receivers are connected in the high tension positive battery lead. This dual amplification circuit is probably the best-known and although it is not claimed to be in any way equal in results to separate valves performing the function of high and low frequency amplifiers, it is a system that produces good all-round results, giving a high degree of amplification of the local station, and at the same time is sensitive to distant transmissions.

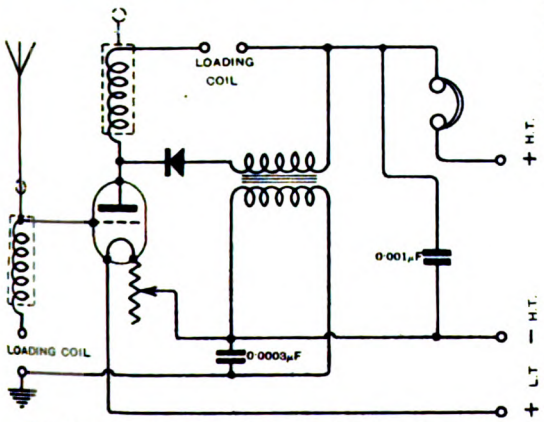


Fig. 1. A reflex circuit is employed and tuning is effected by the inductance change produced when a copper cylinder covers the windings of the tuning coils.

The material required is as follows:—

One cabinet built to the dimensions shown in Fig. 7. To those who may find difficulty in completing a job of this sort it might be mentioned that there are many useful types of containing cabinets available, which can be used, and involve, of course, slight amendment of panel dimensions.

One ebonite panel, 9 ins. by 6 ins. by $\frac{1}{4}$ in.

Two ebonite tubes 4 ins. in length by 2 ins. in diameter.

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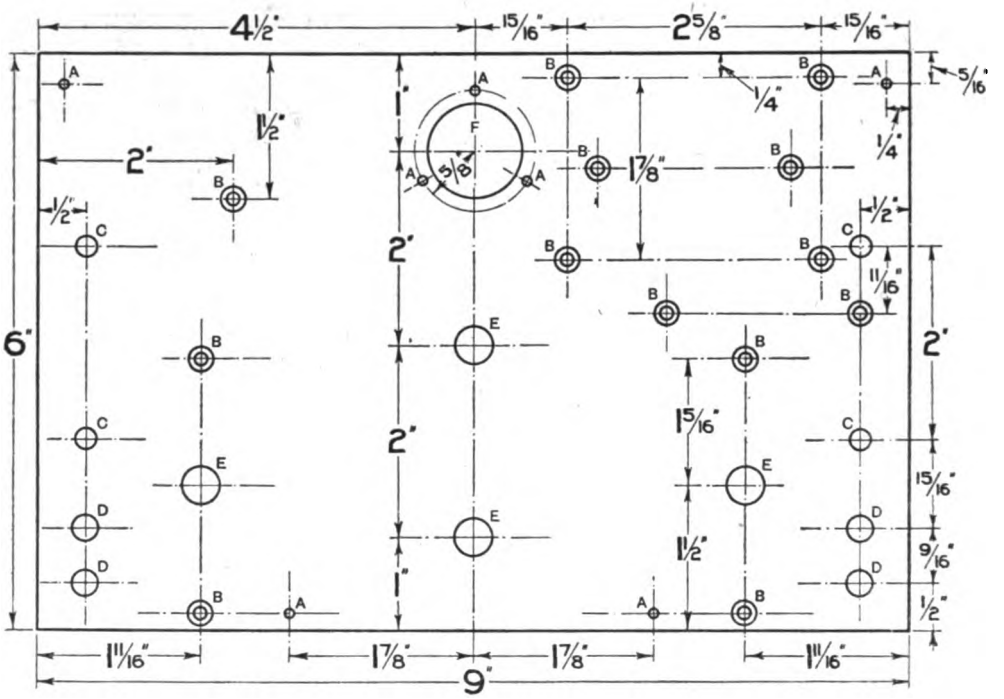

Fig. 2. Details for drilling the panel, viewed from the front. A, 3/32" for No. 3 round headed brass screws. B, ⅛" and countersunk on face. C, 7/32". D, ¼". E, ⅜". F, 1".

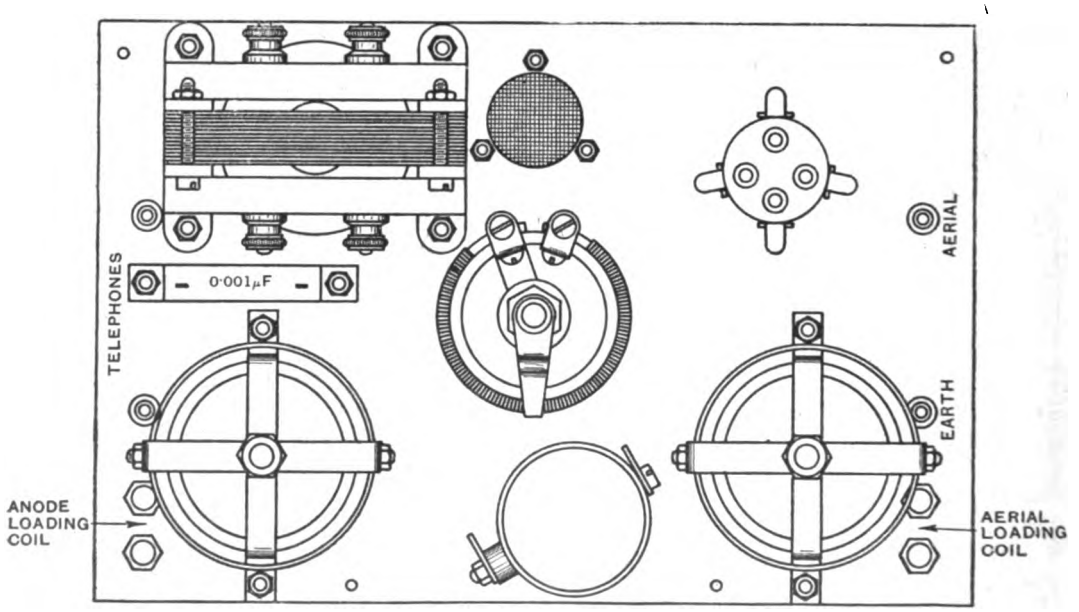

Fig. 3. Arrangement of the components on the back of the panel.

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Two copper tubes 3 ins. in length by 2¼ ins. inside diameter by about No. 20 S.W.G. in thickness.
One filament resistance.
One crystal detector of a type that will provide easy adjustment.
One valve window.
Six " Clix " sockets and 8 plugs.
4 Valve legs.
2 ft. of 7/32 in. brass rod.
18 ins. of brass strip 5/16 in. width by No. 16 S.W.G. in thickness.
2 Small ebonite knobs.
2 Sets of coil plugs and sockets.
2 Fixed condensers, 0·001 mfds.
One intervalve transformer.
4 ozs. D.C.C. copper wire No. 34 S.W.G.
4 ozs. D.C.C. copper wire No. 30 S.W.G.

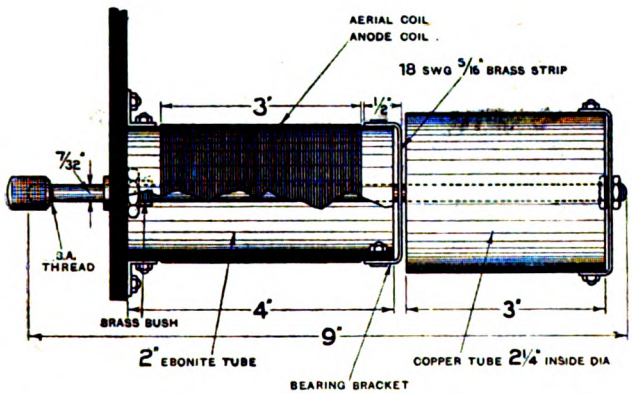

Fig. 4. Constructional details of tuning coil and cylinder.

Some No. 16 tinned copper wire for connecting up.
Screws, nuts, etc.

Referring to the components used in this circuit, the tuning coils are wound on ebonite tube 2 ins. in diameter by 4 ins. in length. The aerial coil is wound with No. 30 D.C.C. and the anode coil with No. 34 D.C.C. The windings cover 3 ins. of the tubes, and are set up according to the details given in Fig. 4, so that the copper tubes pass down over the windings. Suitable copper tube can be purchased at a metal warehouse, and the pieces cut to length, using a fine-toothed blade in the hacksaw. Brass bridging pieces are fitted across one end of each piece and attached to lengths of 7/32 in. rod by means of a centre hole, the rod being threaded 1 B.A. Across the open end of the ebonite tube also is another brass bracket which is drilled 15/64 in. to give good clearance for the rod which slides through. The purpose for using rod of this size is that brass bushes are obtainable for fitting to the panel and through which the rod will slide, If the hole is not found to be exactly the size required, then a 5/64 in. drill must be passed through. Care must be taken in setting up the rod, that the holes through which it passes are in alignment.

The necessary details for drilling the panel are shown in Fig. 2. The panel, as will be seen, is arranged to carry all of the components. The filament resistance is mounted in the centre and the valve window immediately above it. Although the valve is not immediately behind the window, which in this design was not found possible to arrange, the window will serve to indicate as to whether the filament is glowing as the illuminated interior of the box can be seen. To avoid the fitting of terminals in positions somewhat inaccessible, plugs and sockets are made use of for connecting up aerial, earth and telephones. Both the aerial, and tuned plate circuits can be loaded for reception on the longer wavelengths, and for this purpose " U " links with plugs and sockets are fitted to the front of the panel. The tuning rods which operate the copper cylinders are symmetrically arranged on either side of the filament resistance.

The set is simple to make up and to anyone acquainted with the process of squaring up and marking out ebonite, drilling and countersinking, the accompanying practical drawings give all necessary details. These

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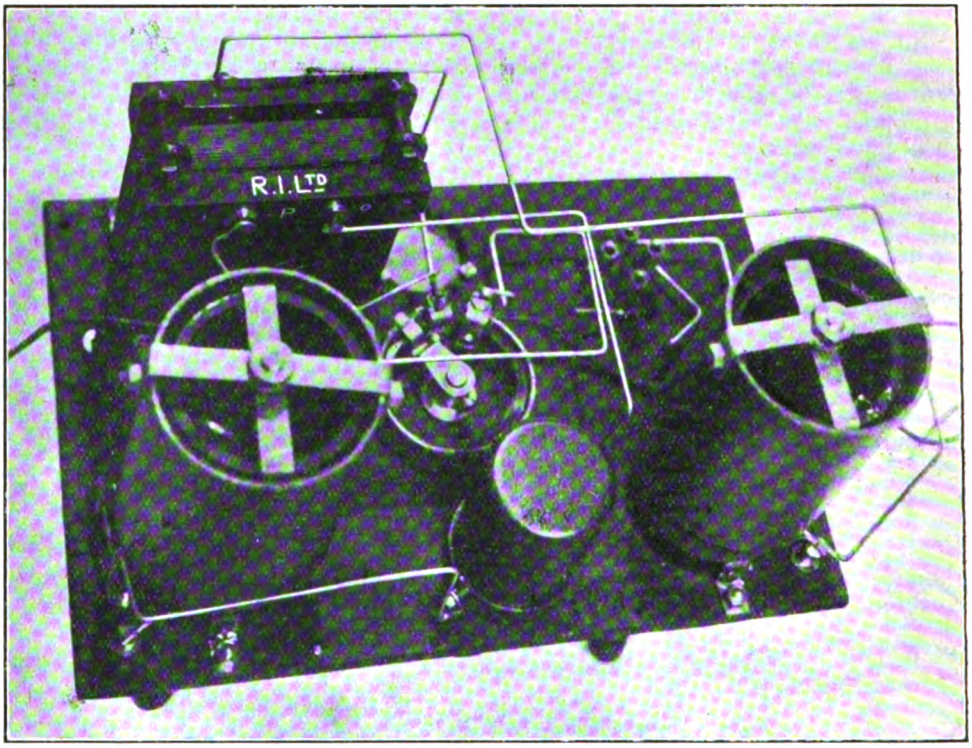

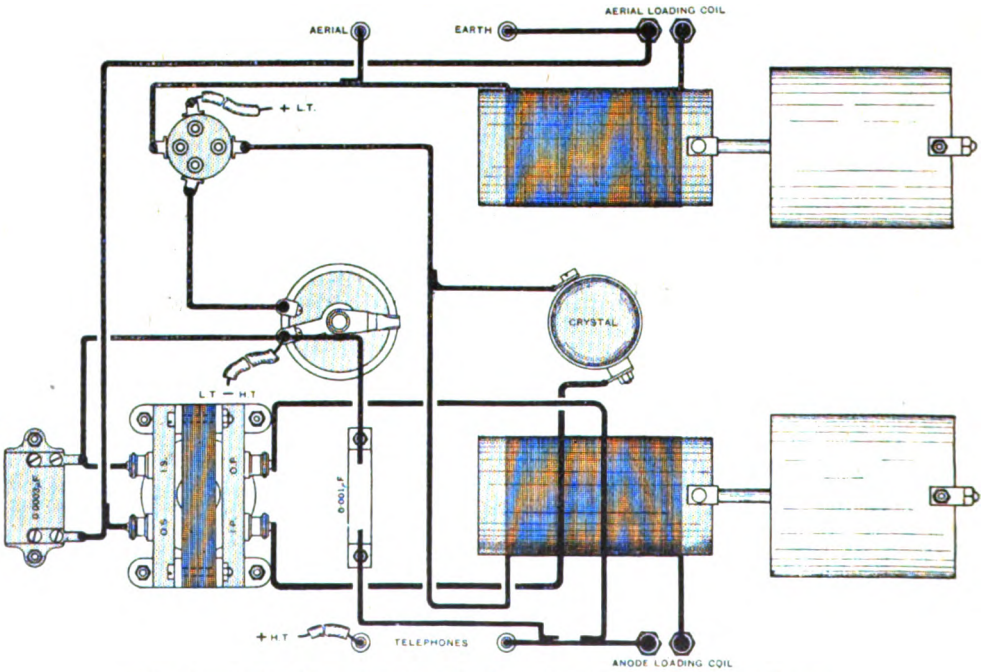

Figs. 5 and 6. View of underside of panel and practical wiring diagram.

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can be worked to without further explanation.

The wiring is carried out with No. 16 tinned copper wire, and as the circuit is a simple one the number of wire leads will be comparatively few.

The panel, when completed, may with advantage be mounted in a cabinet, in which provision is made for the accommodation of the filament and H.T. batteries. A suggested form of cabinet is shown in Fig. 7.

When using a dull emitter valve of the 0·06 class, ample room will be found for including not only the high tension and filament batteries, but also one pair of telephone receivers.

A receiver tuned on the principle described here will not be found to possess great selectivity, which is probably an advantage when simplicity of operation is the aim. The operation of two tuning adjustments simultaneously makes tuning difficult if signals are only received at critical settings, which is the case when a highly selective tuning system is adopted. The comparative flatness of tuning given by this set renders tuning an easy process.

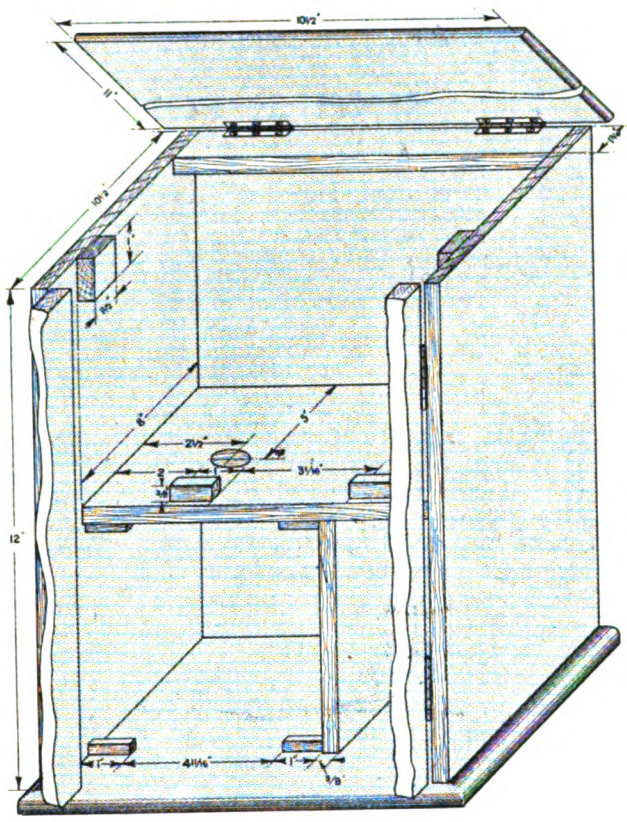

Fig. 7. A suggested cabinet design. Compartments for batteries and telephone receivers are provided.

FIRST STEPS IN WIRELESS

In spite of the large number of publications now available purporting to introduce the beginner to an elementary study of wireless, the little book under review* fulfils its purpose in a manner at once lucid and original. As a guide to the novice its brevity of treatment is a distinct advantage, for while nothing of fundamental importance is omitted, the reader is not confronted with pages of irrelevant and discursive detail.

The principles of wireless are approached in a way which robs them of their mysticism in the eyes of the beginner by means of some apt analogies in the phenomena of sound. An explanation of electric current follows, after which practical advice is given on the erection of aerials and the preparation of a reliable earth system. The reader is then acquainted in turn with the principles of tuning, the telephone, crystal rectification, and finally valve detection and amplification. The concluding chapter treats of the operation of a typical three-valve broadcast receiver.

The great merit of Mr. Pocock's little book is the simplicity and directness of its explanations. The chapters on valve operation in particular are such as to be easily understandable to the veriest novice.

* "Your First Steps in Wireless." By Hugh S. Pocock, (The Wireless Press, Ltd., 12-13 Henrietta Street, London, W.C.2. 60 pages. 25 Illustrations. Price 9d. net. Postage 1d.)

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SOME INTERESTING EXPERIMENTS WITH

SINGLE POINT DETECTORS

The single-point film detectors described here are really improved forms of the so-called "film coherer" and are identical in their mode of operation with crystal detectors. In these detectors the manipulation of the metal point or "catwhisker" is a more delicate matter than in the case of the ordinary crystal detector. They are all easily fitted up and the experimenter may learn some useful lessons by trying them out in conjunction with a theoretical study of the subject on the lines indicated in former articles in this journal.

By JAMES STRACHAN, F.Inst.P.

THE majority of these experiments may be most conveniently conducted by means of a crystal detector in which the crystal cup is replaced by a small spring or screw clamp suitable for holding the various forms of the film supports.

OXIDE FILM ON BRASS.

The contact is made on the milled edge of an unlacquered brass terminal head (Fig. 1), using a pointed piece of No. 26 copper wire as "catwhisker." The milled edge is rotated and various contacts tried until the best results are obtained. The terminal used should not be quite new but should have the dull yellow tarnish. A correspondent advises that he has found the screwed periphery of a 2 B.A. brass rod quite good. The grooves in the milling or screw-cut present the requisite oxide film better than a smooth surface. Manipulation of the "catwhisker" is very delicate, but reception at best is quite equal to a good

Fig. 1. A tarnished brass surface and a copper wire will function as a detector. The milled head of a terminal possesses many faces and detecting contact can more easily be found.

synthetic galena. Various pieces of brass should be tried until results are obtained. A good contact is easily disturbed by vibration. This detector is very sensitive to sudden increases in aerial current, which produce repulsion and breaking of the contact. A poor contact is much improved by the use of an applied potential.

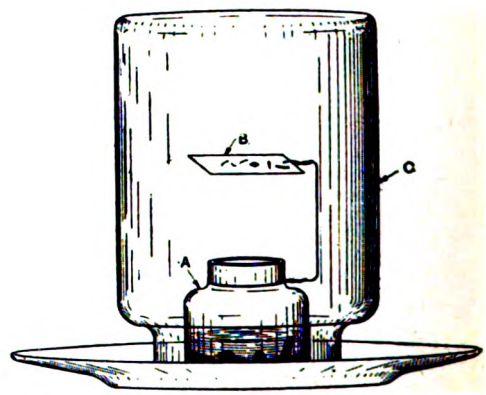

Fig. 2. Method of forming a sulphide film. Sulphuretted hydrogen is evolved from the iron sulphide and hydrochloric acid in A. The metal pieces to be treated are supported on the platform B.

OXIDE FILM ON COPPER.

The black oxide film on copper is most conveniently prepared by dipping a fragment of thick copper wire or of sheet copper in a strong solution of copper nitrate and heating the metal until a uniform black film is produced. The solution should be slightly acidified by adding a few drops of strong nitric acid. This preparation is not nearly so sensitive as the oxide film on brass, but works very well with an applied potential. When thick wire is used, a good contact may be established by allowing the catwhisker to cross at right angles, resting lightly upon it.

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SULPHIDE FILMS ON VARIOUS METALS.

Sulphide films on various metals may conveniently be obtained by exposing the cleaned metals, such as lead, copper and silver, to a moist atmosphere, containing sulphuretted hydrogen gas, until the metal is thoroughly blackened. A simple method of doing this is shown in Fig. 2.

A one-ounce wide mouthed bottle A carries a support B of wire and celluloid on which the fragments of metal to be sulphidised are laid. A few fragments of black iron sulphide are placed in A and some spirits of salts (hydrochloric acid) added. The large glass jar C is then inverted over the apparatus, which may conveniently rest on a china plate. This operation should not be conducted in the drawing-room as the smell is unpleasant. Sulphide films prepared in this way require a delicate contact with the catwhisker and work best with an applied potential. Sulphide films may also be prepared by heating the metal in a glass test-tube to dull redness and dropping in a few grains of powdered sulphur while the heating is continued. In the case of lead the latter melts and a black film is formed on the surface. When cold a lead button is produced with the sulphide film on the flat surface. A hard glass test-tube should be used and a bunsen gas-flame. This method is quite useless with some metals, such as silver, but works well with lead and copper.

AMORPHOUS POWDER DETECTORS.

Sulphides and oxides may be prepared in the amorphous form most conveniently by precipitation, filtration and drying. Experimenters who are not familiar with such operations should purchase the pure substances from some chemical warehouse of repute, such as the British Drug House.

Fig. 3. The terminal head is covered with a piece of thin platinum foil for conducting experiments with amorphous powder detectors.

Various methods of using the powdered substances as detectors may be employed. The majority of my own experiments were carried out by spreading a film of the powder on the flat surface of a brass binding screw-head on which had been soldered a disc of platinum foil (Fig. 3). This was clamped in the crystal holder and the catwhisker applied vertically.

Another method of preparing the film is to mix the powder with a drop of distilled water, spread it over the surface of the metal and dry by application of a gentle heat. Another method is to mix the powder into a paste with olive oil or liquid paraffin, and spread a film of the paste over the metal. Practically all substances which rectify in the crystalline state, also rectify in this condition of amorphous powder, but it is necessary to use an applied potential to obtain good results.

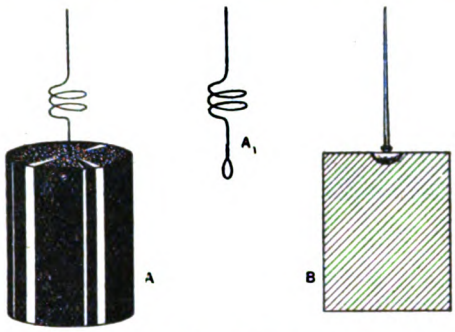

Fig. 4. A piece of arc carbon may be employed for making contact with powdered detecting substances.

The most remarkable of these experiments lies in the fact that in many cases it is sufficient to use an applied potential for a few minutes only when the contact rectifies well after the local battery is switched out, so long as the contact is not disturbed. Each new contact requires sensitising in this way.

Fig. 4 shows two other very successful methods of using amorphous powders as rectifiers. In A the film is prepared by rubbing the powder over the end of a short piece of arc-lamp carbon with the forefinger and applying the catwhisker vertically. In many cases better results are obtained by using a cat-whisker with a blunt end or bent into a loop as A_1.

In B is shown (in section) another method of using the carbon rod film carrier. On the upper surface a shallow cavity is excavated, into which the powder is placed and in this case the catwhisker is an ordinary pin, the head of which is applied, varying the pressure, to the small pinch of powder in the cavity.

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Yet another method lies in dusting the finely ground, dry, sieved powder, on to the surface of some dry mercury in a small wide-mouthed glass tube (Fig. 5).

Contact with the film-covered mercury is established by means of a piece of stout iron

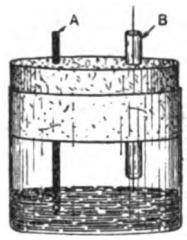

Fig. 5. An experimental detector in which the powdered detecting substance is floated on the surface of a small quantity of mercury.

wire A, while the catwhisker is applied through a short piece of glass tubing B, both of which are carried by the cork (soaked in paraffin wax), which closes the tube.*

CARBON FILM DETECTORS.

A piece of platinum foil coated with a carbon deposit by holding it in a tallow candle flame for a few seconds gives a film that rectifies quite well, using an applied potential.

A graphite film made by rubbing powdered graphite on the carbon rod (Fig. 4, A) is more efficient.

In Fig. 6 is shown a curious form of carbon film detector discovered accidentally.

A small spirit lamp A is burned until the business end of the wick is well charred. While still burning, a piece of stout copper wire is pressed into the charred wick for one contact and the catwhisker (a platinum wire) C applied vertically to the char. The two wires must not touch but they should both make contact with the carbon char. This works well with an applied potential.

THORIA FILM DETECTOR.

Thoria (oxide of thorium) is ground into a paste with distilled water and applied to a piece of platinum foil or stout platinum wire. When dry the platinum is held in the flame of a small spirit lamp or a very small Bunsen gas-flame. Contact is established with the film by applying a thin platinum wire catwhisker when the platinum is red-hot (Fig. 6).

CRYSTAL FILM DETECTORS.

As the majority of amorphous rectifiers used in the film detectors described above require the application of an applied potential to obtain the best results, they are much more difficult to manipulate than crystal detectors, particularly as sudden variations in the potential across the contact, disturb the latter and frequently break it. It is interesting to note, therefore, that all good crystalline rectifiers may be ground up in an agate mortar to a finely crystalline powder which still rectifies quite as well as the large crystal. Such powders should be sieved through fine bolting-silk (200 meshes per lineal inch) and used in many of the above experiments without the use of an applied potential.

CONCLUSION.

It is not suggested that any of the detectors described above are efficient substitutes for the crystal detector. My purpose in describing them will be served if this article

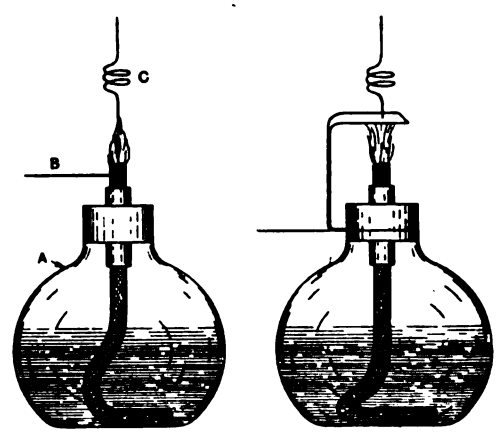

Fig. 6. The carbonising of the wick of a spirit lamp forms a detector using platinum wire contacts. The spirit lamp on the right carries a piece of platinum foil coated with thoria. This gives a detecting surface when red hot.

stimulates the amateur to carry out other experiments on similar lines. The real value of theories can only be grasped when theoretical studies are carried on in conjunction with practical work.

Such experiments not only help one to obtain a better grasp of the theory of rectification, but the manipulative skill required in getting them "to work" is most useful in other directions.

* Keep mercury away from wireless apparatus and avoid such things as mercury grid leaks and mercury vernier condensers as you would a corrosive acid. One drop of mercury will give off enough vapour to corrode all the aluminium in a wireless set.

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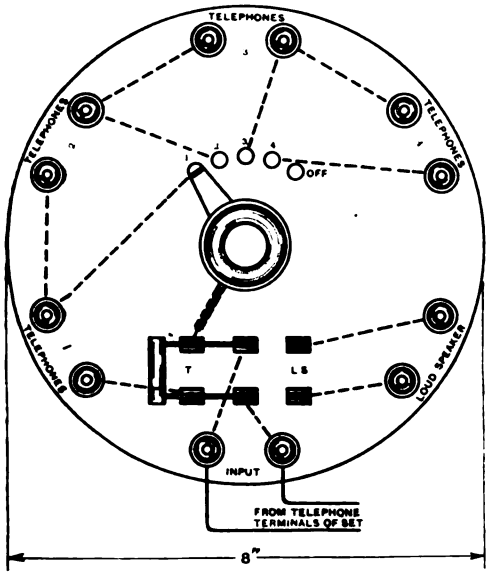
READERS' PRACTICAL IDEAS.

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Telephone Terminal Block.

WHEN telephones are employed in preference to a loud speaker a distribution point must be made to which all telephone cords may be attached. As the



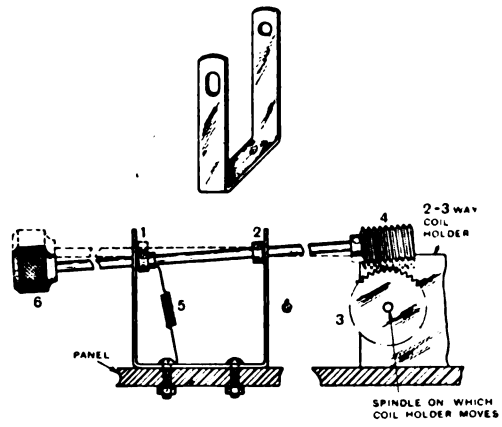
Telephone distributor board for varying the number of receivers in circuit.

number of pairs of telephones in use is to be changed it is necessary to set up some form of switch for easily throwing out of circuit those receivers not in use. Such a switch, of simple construction, can be made up from a circular piece of wood or ebonite carrying four pairs of terminals for four sets of receivers, and a five-point switch for bringing them into operation. If the loud speaker is to be operated a double pole switch may be added to the instrument for bringing it into operation.

G. H. W.

Worm Drive Attachment.

THE simple device described here may easily be fitted to many types of coil holder, and in use gives just that difference between good and bad long distance reception, as the sensitiveness of a set as a rule depends upon the critical adjustment of the relative position of the inductances. A Meccano gear wheel and worm are used in its construction, together with two adjusting collars and set screws and one axle rod. The gear wheel is attached to the spindle of the moving coil holder, while the worm drive is attached to a brass spindle and is carried by a bracket made from strip metal. It is not



A simple method of obtaining fine coil adjustment. The spring holds the gears out of mesh for coarse tuning.

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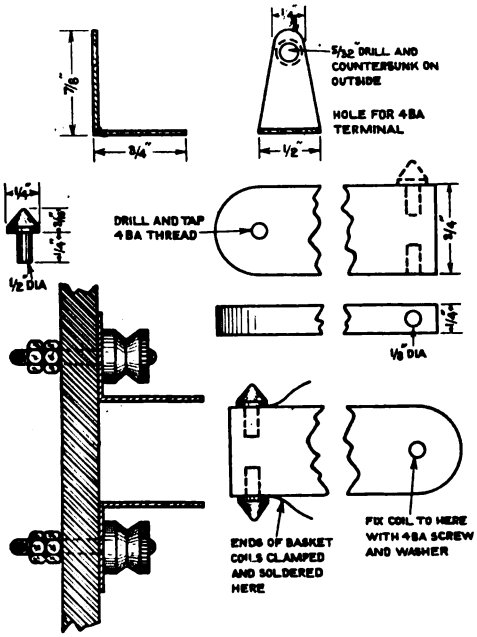
intended that the worm drive action shall be used to propel the coil holder when making coarse adjustment, and for this reason a small spring holds the worm wheel out of contact with the pinion. A slot in the end of the supporting bracket allows of the worm wheel being brought into mesh and the necessary critical adjustment obtained.

J. G. S.

A Simple Coil Mounting.

THE accompanying drawings are self explanatory in giving a method for easily constructing a very useful form of coil holder. It will be noticed that small



An easy method of constructing a useful form of coil holder.

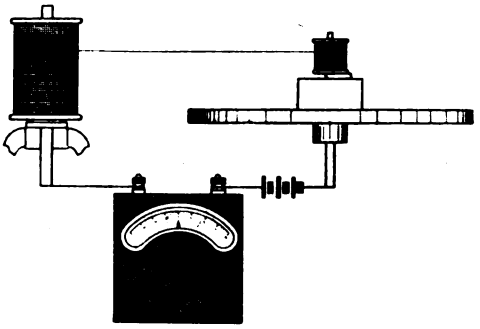
brass pins are used to make contact between the arm which supports the coil and the two springs forming a bracket. Suitable dimensions are given.

H. H. P.

Winding with Fine Wires.

IN the construction of intervalve transformers and the re-winding of telephone receivers, insulated wire of exceedingly fine gauge and poor mechanical strength is used.

Extreme care is necessary in handling this wire, particularly as the insulated covering is usually stronger than the copper conductor it contains. As a result a bobbin may be



A galvanometer used to detect a break when winding fine wire.

wound in which the wire runs on continuously although an actual break may have occurred in the copper conductor. To guard against this, the reel from which the wire is drawn will be found to have the inside end brought out so that connection can be made to it, and by joining up the whole of the wire in circuit with a battery and sensitive galvanometer it is possible to detect a break immediately it occurs.

Small bobbins can be rotated by means of a clockwork motor such as that used for driving a gramophone. The coil to be wound must be mounted on a block of wood and arranged to run quite centrally to avoid any jerking action on the fine wire.

A. E. R.

Soldering Water Main Earths.

ONE of the most convenient methods of obtaining an earth connection is to employ the main cold water supply pipe. Owing to the heat conducting properties of the pipe it is an extremely difficult matter to solder a connecting wire to it when employing ordinary methods. The difficulty can be overcome by using a solder having a much lower melting point. A number of fusible alloys are suitable for the purpose, and one which has been used successfully for this purpose has the following composition in parts by weight: bismuth 3, tin 5, and lead 3. It is advisable to tin the copper wire and soldering bit in the usual manner with ordinary solder, and to bind the copper wire in position on the water pipe with thin tinned copper wire.

F. F.

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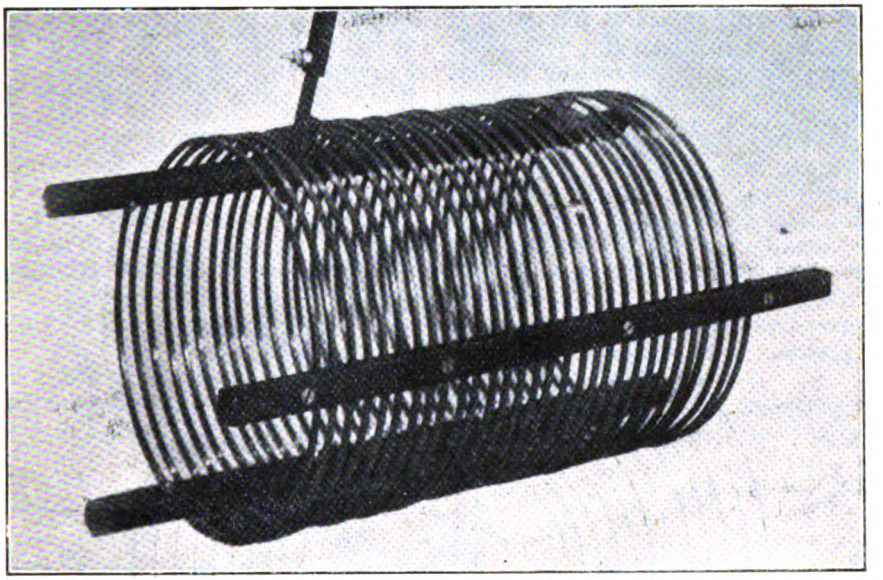

A useful form of air-spaced transmitting inductance.

THE DESIGN OF TRANSMITTING INDUCTANCES.

An article principally of interest to operators of transmitting apparatus. The design of inductances for use with valve transmitting apparatus has not previously formed the subject of an article, and it is felt that the information given here will be welcomed by many transmitters at the present time, when apparatus of extreme efficiency is being designed. Coils of the type shown possess minimum losses, and are capable of handling energies customarily employed in amateur stations and at the high radio frequency of the low wavelengths.

By N. V. WEBBER.

IN this article it is proposed to leave the calculation of the size of the actual inductance alone, and to ascertain these details the writer would recommend one of the many text-books published by the proprietors of this journal. Assuming that the dimensions are known, I will proceed to describe two types of inductances which are very popular amongst transmitters and which are very useful for short wave work. The pancake type is undoubtedly the easiest to construct, and this type will therefore be dealt with first. The internal diameter of this is 3 ins., and 12 turns are employed spaced ¼ in. apart. First, in order that a host of calculations may be dispensed with, it is advisable to make a full-sized drawing of the proposed inductance. This need not be a very accurate affair, but should at the same time be sufficient to provide the necessary measurements.

Two lines should be set out at right angles on the drawing paper, and the arms numbered from one to four in rotation, either clockwise or anti-clockwise, it does not matter which, so long as all the inductances are made in the same way, and the winding is in the same "sense." A mark should be made on the

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sketch on No. 1 arm at a point $1\frac{1}{2}$ ins. from the centre. In order that the winding will be worked outwards in spiral formation it becomes necessary to make the next point on No. 2 arm slightly out of register to that marked on No. 1, the exact measurement from the centre being $1\frac{9}{16}$ ins. It will thus draw the remainder. A line is also needed joining points equidistant from the centre. Thus should be bisected and a line drawn at right angles. The line should be at least $\frac{1}{2}$ in. from the last turn, and the point where it cuts the arms of the cross will show their length.

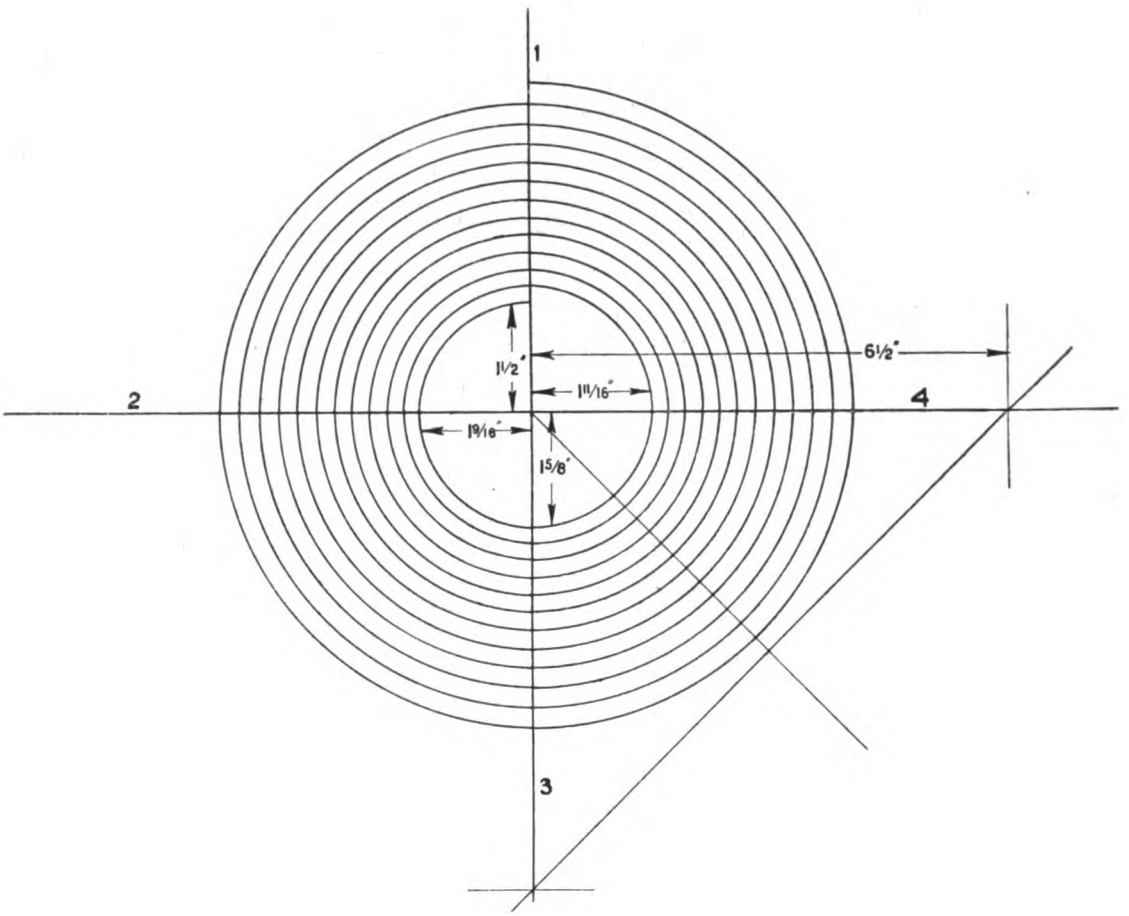

Fig. 1. A full-size drawing of the spiral should be prepared. The method of setting it out and the necessary dimensions is given here.

be appreciated that the marks on the arms 3 and 4 will be $1\frac{5}{8}$ ins. and $1\frac{11}{16}$ ins. respectively.

Having fixed the four points it is only necessary to mark outwards along the arms, points $\frac{1}{4}$ in. apart, until there are twelve to each side, when the position which the wire will occupy when it is wound on can be sketched. After a few turns have been completed, it will be found unnecessary to

The drawing completed, the ebonite strips may be cut, the width of which depends upon the width of the copper strip to be used. In the case of the inductance under description the strip is 5/16 in. wide, and so if the ebonite pieces are cut $\frac{3}{4}$ in. wide by $\frac{1}{4}$ in. there will be ample support. The two strips in this case are cut 13 ins. long, and form the cross. Whilst the ebonite is being cut it would be well to make up two more strips

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each ¼ in. square and 13 ins. long for use as clamps to keep the spiral in place. The next operation is to mark the ebonite for slotting. Centre the ebonite and mark off two points on either side of the centre, 1½ ins. and 1⅝ ins. respectively, which should be numbered 1 and 3. The other points can then be marked out as they appear on the drawing. With a set square lines should be scribed across the strip, and a line should be drawn on the ebonite which is the width of the copper ribbon from one of the edges. It is also necessary to draw in the centre of the ebonite arm a short line which is exactly half the width of the strip, *i.e.*, ⅜ in., and then two lines ⅛ in. from the centre. This performance should be repeated with the other piece of ebonite, which should be numbered 2, 4. (Fig. 2).

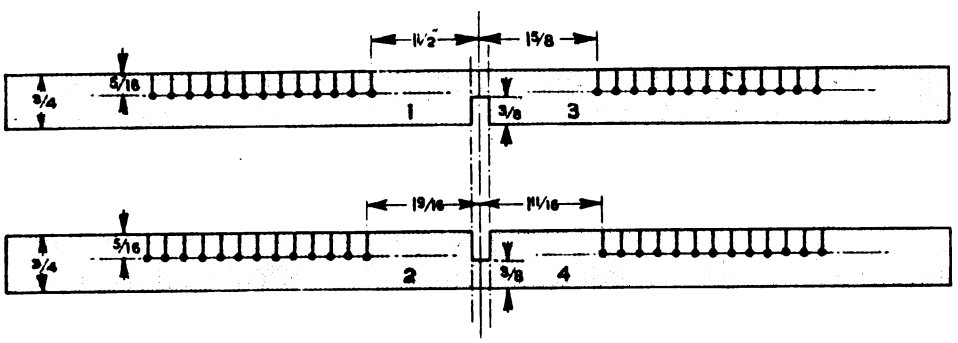

Fig. 2. The method of marking the ebonite strips for slotting.

The strips having been marked, the centre slots should be carefully cut with a fretsaw and the cross made in a similar manner to that in which an egg-box is constructed. If the joint is made to fit too tightly the ebonite will be bent and a flat inductance will not result. Before the various slots are cut in the strips, particular care should be taken to ensure that when the cross is assembled the slots will all be on the upper side. The slots are cut with a hacksaw, the ebonite being firmly gripped in a vice. A hacksaw blade should be chosen which is the same thickness as the copper strip, and as each cut is made a small length of the ribbon should be inserted.

The whole secret of a successful inductance lies in the fit of these slots. The copper strips must fit into the slots easily, and should not have to be forced in at all, yet they must not be too loose or difficulty will be encountered when the wire is wound on. When the twelve slots have been cut take the strip out of the vice, and holding the unslotted end, give it a tap on the bench, and all the copper strips should fall out. If they do not do so they are too tight a fit, and the slots must be widened a little by running into them the back of an ordinary wood saw. All the slots having been cut, the strips should be rubbed over with emery to remove the scribed lines. The selection of the strip is an important point, for if it is of the correct type winding the coil is the easiest task of all.

The strip used in the construction of the coil under description is 20 S.W.G. 5/16 in. wide. It is essential that it should be soft copper for if it is hard drawn, difficulty will be experienced in bending it to the correct shape. The strip employed in this case was obtained from Messrs. Young's, of City Road, E.C. If only hard copper can be obtained it can be softened by heating it until it is at a dull red heat, and then cooling it in water, but this is rather a tedious operation. The amount of strip which is required should next be cut from the coil. This can be roughly determined by taking the length of the sixth turn on the drawing, and multiplying it by twelve, adding an extra foot to allow for accidents. This length of wire should be taken into the garden and the ends fastened so that the wire is stretched out, when it can be cleaned

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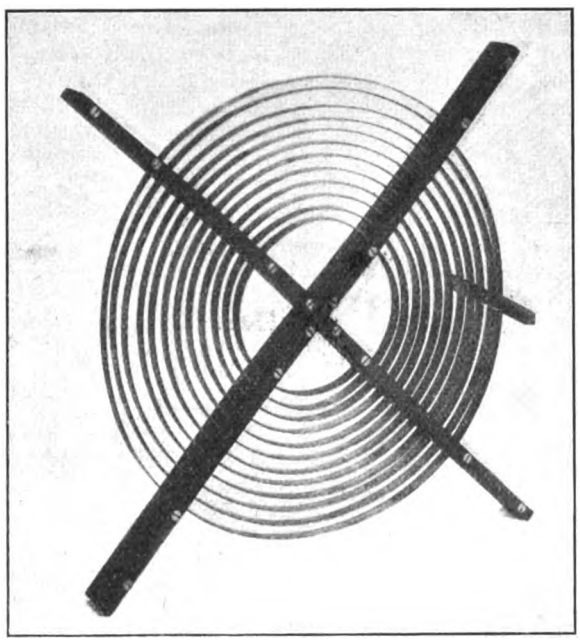
with emery paper. Upon the completion of this operation the wire should be wound into a coil having a diameter of 1 ft. 6 ins.

The cross being fitted together with the numbers running consecutively, it is placed on the floor and kept in position by means of staples or long panel nails. Taking one end of the wire it should be placed in slot No. 1, and then bent into the shape of the curve and put into slot No. 2, then No. 3, then No. 4, and then to the second slot on No. 1. The first turn is then complete. Continue winding until all the slots have been filled and cut off any surplus wire. The inductance is therefore finished with the exception of the top strips of ebonite which are to keep the wire in place. These strips are placed on top of the wire and screwed on. It will be necessary to cut one of the rods in half, for to construct this cross in a similar manner to that in which the larger one was made would involve a great amount of unnecessary trouble. Eight screws are used to keep the longer strip in place, and four for the shorter pieces. These do not go right through the ebonite strip, but holes are drilled nearly through, and are then tapped with a 6 B.A. bottom tap. Where facilities exist for making suitable screws in fibre it is quite worth while substituting them for brass, in view of the losses which are liable to occur when metal parts are assembled in close proximity to the turns of the coil. The method of making clips for this type of inductance is described at the end of this article.



A pleasing and symmetrical appearance is preserved in the finished inductance.

The solenoid inductance has not so many constructional details, but it is more difficult to construct owing to the fact that it is not easy to wind the wire round absolutely evenly. The inductance to be described has a diameter of 5½ ins. and consists of 30 turns spaced ¼ in. apart. A length of ⅜ in. square ebonite rod is necessary, which in this instance is 10¼ ins. long, this allowing 1½ ins. at each end. Three of these rods will be required. With a scriber one of the sides should be centred and a line marked 1½ ins. from one end and a line every ¼ in., until there is a total of 30 points. These points, which must be exactly in the centre of the rod, should be centre-punched and drilled, care being exercised that the drill is exactly the same size as the wire to be used. When one rod is drilled it can be used as a jig for the others. The sides of the rods will have to be drilled with a 6 B.A. clearance drill, for this rod is to be split down and these side holes used to clamp the two halves together. In drilling these holes care must be taken that they go between the holes which take the wire, otherwise there will be a danger of shorting the inductance.

Four screws are required for each rod, which are placed, one at the top, one between the 10th and 11th turns, one between the 20th and 21st holes, and the other at the bottom. When these holes have been drilled and countersunk, the rod is cut down through the 30 holes by means of a fretsaw. For this inductance 12 S.W.G. bare soft copper is used, the length required being ascertained by measuring the length for one turn and multiplying it by 30 and allowing an extra foot.

The wire is taken, straightened and

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cleaned in exactly the same manner as the copper strip. Unless one is in possession of a lathe the wire should not be released. A former should be obtained slightly less in diameter than the finished coil is to be, to allow for expansion.

Two substantial pieces of wood should be nailed into each end of the former, to which one end of the wire is securely fastened, the other end of the wire remaining as it was for cleaning. It then becomes a fairly simple matter to wind on the wire, keeping the turns as close to each other as possible and winding without stopping, applying an even tension. Holding both ends of the wire securely, cut it off from its fastening and then release both ends simultaneously, when the wire will uncoil and expand to the required size. It is important that this procedure should be adopted, for should both ends not be released at once the end which is held last will be smaller in diameter than the other.

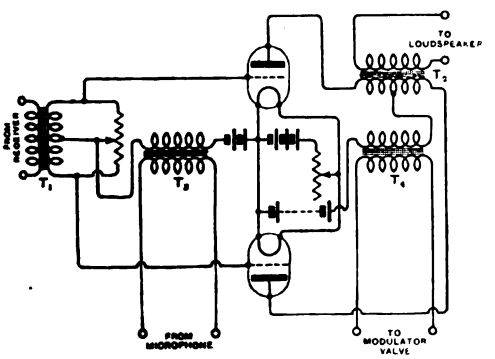
Taking one of the rods, fit in a screw and nut at one end and place the first dozen turns into the slots provided, when the second bolt can be placed in position and the two tightened sufficiently to hold the turns in place. Continue until the next ten turns are wound, and slip in the next screw. The final screw should be left until the other clamping rods are placed in position when the three rods can be equally spaced round the inductance and all the screws fully tightened. Any wire over the 30 turns should now be cut off. The inductance will be found to be perfectly steady, and not inclined to wobble. To finish the component the ends of the screws inside the inductance should be cut off flush with a pair of wire cutters. Should a lathe be available it is, of course, advisable to use this for winding, but with care a hand-wound coil can be made very evenly, as will be seen from the photograph illustrating a hand-wound example.

Regarding the clips for these inductances, the pancake type are extremely easy to construct. From the copper strip a length of 3 ins. is cut and bent over 1 in. from the top. The part which is bent over should be pressed in a vice and the short end slightly splayed out with a pair of ordinary pincers. A short length of square rod is slotted and the lower end of the copper strip inserted and clamped in position by a bolt, care being exercised to ensure that the screw makes good contact with the strip. The clip for the solenoid is made in a similar manner except that, when the end is being bent over, a small drill or length of wire is inserted in order to make a slot for the wire. This must be small enough to fit tightly on to the wire of the inductance, otherwise it will sag downwards and short the turns.

PUSH-PULL AMPLIFICATION.

By GUSTAV LAMM (Swedish **SMZY**).

The writer has found an amplifier wired as indicated in the accompanying figure.



very useful. It will be observed that the "push-pull" system is employed. The transformer T_1 is connected to the receiver, and incoming signals are applied through this transformer to the grids of the two valves. In the output circuit is a transformer T_2 with a split primary winding and a secondary winding to suit the loud speaker.

When the instrument is to be used as a speech amplifier in conjunction with a valve transmitter a microphone is connected to the transformer T_3, which applies the speech voltages to the grids of the two valves in parallel. In the output circuit is the transformer T_4, which is connected to the modulator valve.

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PATENTS AND ABSTRACTS

Crystal Detectors.

In ordinary crystal detectors of the type having an adjustable fine wire contact, provision is usually made for placing the end of the wire on any spot of the crystal, and the attention of designers has been devoted to producing a device which will admit of a delicate but firm adjustment.

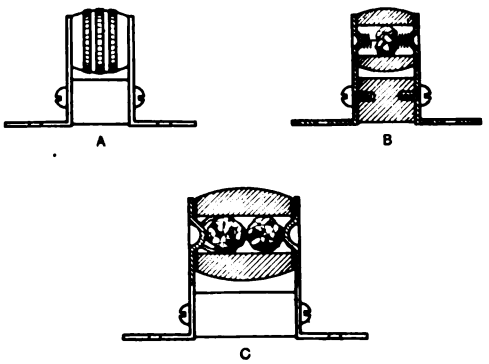

Fig. 1. Crystal detectors which may be adjusted by turning the barrel.

The detectors sketched in Fig. 1 were designed with a view to simplifying the setting of the detector (Patent No. 220,473) Fig. 1A is a side view of the detector, and Fig. 1B a section showing one arrangement of parts. A pair of flexible clips, pressed inwards at their upper ends, are mounted on an insulating base. Between the top portion of the clips is mounted a container of insulating material, which may be rotated, and inside this container is a crystal and two springs. The springs are fitted over the pressed-in portion of the clips. One serves to keep the crystal in position, and the other, which has a pointed end, serves as the wire contact. To adjust the detector, it is only necessary to rotate the container.

Another form of detector in which two crystals are employed is sketched in Fig. 1C.

A Single-Valve Receiver.

British Patent No. 221,951 discloses the circuit of Fig. 2, which has several novel features.

It will be observed that the aerial circuit is tuned by a coil L and tuning condenser C, and is coupled by one turn to a closed circuit A. The aerial coil L is not coupled to circuit A. Connected between the grid and the positive terminal of the plate battery is a tuned circuit B, comprising a coil L_1 and a tuning condenser C_1. Coils L_1 and L_2 are mounted on the same former, but they are slightly separated. Circuit A is not tuned to the wavelength of the incoming signal. In the plate circuit of the valve is the usual reaction coil R, which is wound over the

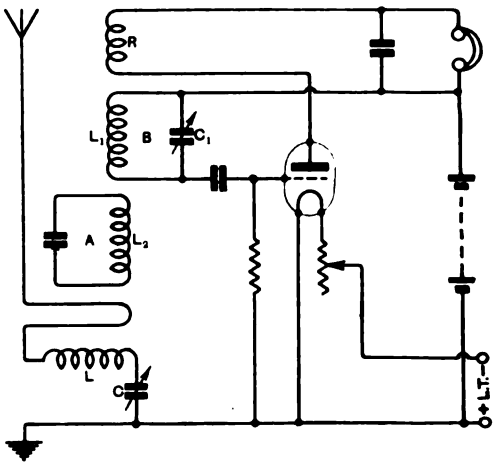

Fig. 2. Connections of a single valve receiver which it is claimed is very selective, and gives good amplification.

end of coil L_1. Coils L_1 and L_2 are wound with thick wire, and the reaction coil with fine wire.

It is claimed that a receiver connected according to this diagram gives results

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which are considerably in advance of the results obtained with ordinary circuits employing more than one valve.

of the interfering notes, but to pass the speech and music. Hence the original quality of the transmission is completely restored.

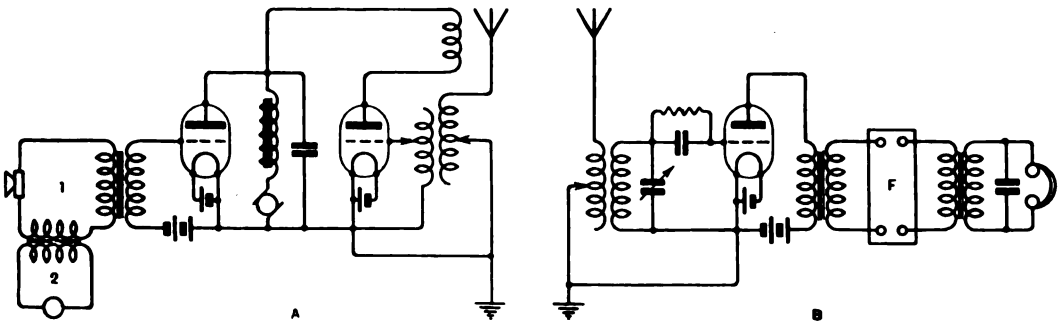


Fig. 3. Connections of a transmitter and receiver employed in one system of "restricted" wireless telephony.

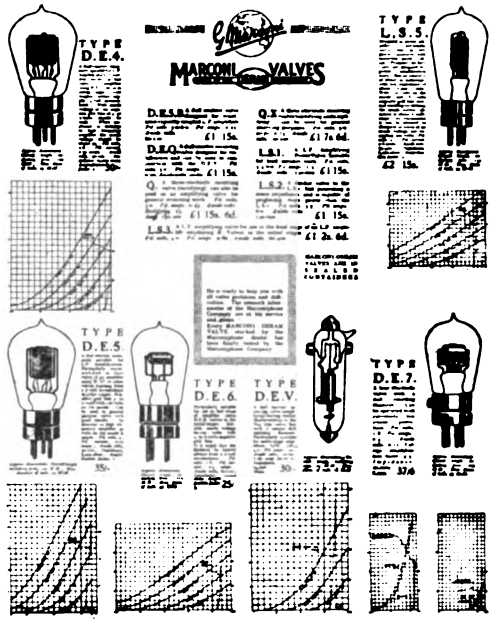
Restricted Wireless Telephony.

In broadcasting systems as used at present, any person having a wireless receiver capable of receiving the wavelength on which the music and speech is transmitted may derive full benefit therefrom, regardless of whether such persons contribute towards the cost of operation of the broadcasting station. It is therefore desirable in some instances to limit the reception to authorised stations.

A specially arranged transmitting and receiving apparatus designed with this end in view (Patent No. 198,368) may be explained by referring to Fig. 3. Fig. 3A gives in outline the connections of the transmitter, and Fig. 3B of the receiver. The design is such that the oscillator of the transmitter is modulated by the speech or music which actuates the microphone, and by certain other tones, which may be very low tones, say 30 cycles per second, high tones above the normal range of speech or music, or by combinations of tones. In the figure, circuit 2 represents the source of the tones which are superimposed on the speech currents flowing in circuit 1. The grid of the control valve therefore receives voltages due to speech or music, and due to the interfering tone. At the receiver we have the ordinary tuning circuits, but if these alone were used, the speech heard would be unrecognisable, owing to the strong tones present with the speech. A filter, F, is therefore connected in the receiver. The purpose of the filter is to prevent the passage

A USEFUL POCKET FOLDER.

The Marconiphone Co., Ltd., have for issue a folder giving in brief operating instructions for the valves in general use.



This folder, one side of which is reproduced here, should prove an indispensable guide to all valve users.

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THE MEASUREMENT OF SMALL CAPACITIES.

The usual bridge method is employed, and the variable standard capacity comprises two condensers connected in series.

IN wireless receivers there are certain very small capacities—for example the capacity between the electrodes of a three-electrode valve. These capacities may be of the order of a few micro-microfarads, or as small as 1 micro-microfarad or less, so that they cannot be measured by ordinary bridge methods; but they often play an important part in the operation of the set. Hence it is important that they may be determined accurately.

A bridge* found very convenient for this purpose is shown diagrammatically in the figure.

A difficulty which arises is the need of a variable standard of capacity which is capable of extremely fine adjustment, and which has a very open scale already calibrated. For such a standard two condensers connected in series may be employed, the capacity of one being large compared with that of the other.

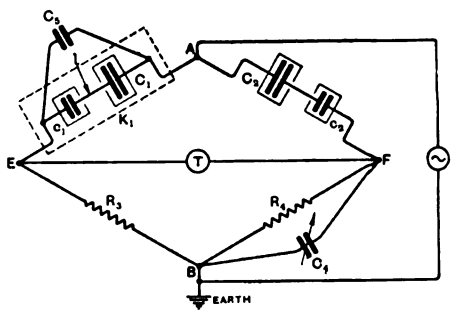
If K is the capacity of the combination, then

$$K = \frac{c\,C}{c + C}$$

If now $\frac{c}{C + c}$ is arranged to be 0·1, then if C is changed by 1 micro-microfarad, the capacity of the combination is changed by 1ooth of this amount. If C is an ordinary variable air condenser, calibrated to read micro-microfarads directly, then by putting a suitable small condenser in series with it, the scale of C may be made direct reading in hundredths or even thousandths of micro-microfarads for small changes of capacity of the combination.

The condenser to be tested (C_5) is connected by means of a pair of rigid leads in arm No. 1 of the bridge, in parallel with the standard condenser K_1, made up of two condensers, c_1 and C_1.

Arm No. 2 of the bridge is practically a duplicate of arm No. 1. Arms 3 and 4 consist of non-inductive resistances, R_3, R_4, each of 5,000 ohms, and in parallel with one of these is a small variable condenser, C_4, which is for the phase angle adjustment. These resistances and condenser C_4 are all enclosed in metal screens, which are connected to the earthed point B of the bridge. The screens for the large condensers C_1 and C_2 are connected to the point A. The screens of c_1 and c_2 are connected to the points E and F respectively. These condensers must be placed as far away from the observer as possible, so that their capacities to earth are as little as possible affected by his movements.



Connections of the capacity bridge.

The voltage applied to the points A and B is raised until the sensitivity is sufficient, the voltage which can be applied being only limited by what the condensers will stand. Several hundreds of volts may be used quite safely in nearly all cases. The bridge takes very little power, and thus a very small transformer is sufficient to step up the voltage to the required amount.

In practice the leads to the bridge may be connected to a coil of several henries inductance, and this coil coupled to the inductance coils of an oscillating valve set until the required voltage is obtained. The capacities c_1 and C_1 include the capacity between the lead l and the screen of the condensers. The leads should be of fine wire, and this lead capacity should be included when c_1 and C_1 are calibrated.

* Proceedings of the Physical Society of London: "A Method of Measuring Very Small Capacities."

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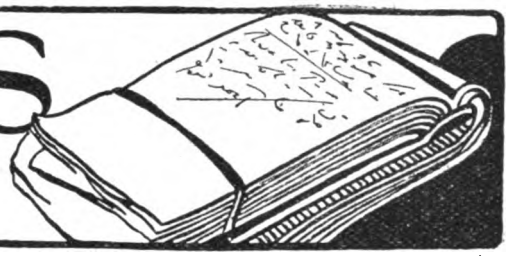
NOTES & NEWS



The opening of the first regular wireless service between Sweden and America took place on October 31st, messages being exchanged between Varburg, near Gothenburg, and Long Island.

* * * *

On Friday, November 7th, the new premises of the Glasgow broadcasting station were opened. These are situated at 21 Blythswood Square and 4 Jane Street.

* * *

The Free Commune of the Island of Saint Louis, in the heart of Paris, is establishing a broadcasting station.

* * *

The new Dundee relay broadcasting station (**2 DE**) transmits its first programme this evening (Wednesday).

* * *

BEAM WIRELESS IMPROVEMENTS.

An interesting announcement has been made by Senator Marconi, who has returned to London after an experimental voyage of three months. During this time he has been further developing his new "beam" system, with the result that the system will, he states, be effective for efficient telephone service over any distance by day as well as night.

NEW LOG RECORD.

The possibility that Australian amateur signals had been received in this country as early as October 6th by Mr. R. W. Galpin, **5 NF**, was hinted at in our issue of October 29th.

We are now assured, however, by Mr. S. K. Lewer (**G 6 LJ**), who heard the transmission in question, that the nationality prefix was "U" not "A," which would at once identify the transmitter as American. Mr. Lewer adds that he has heard this station (**U 2 ADJ**) several times, and that there can be no doubt as to its nationality. Mr. Lewer claims to have beaten the record log for one evening, claimed for Mr. W. A. S. Batement in our issue of October 29th. On the same night, *i.e.*, October 12th, **6 LJ**, using one valve, logged 93 American amateurs, included in all of the nine districts. Since the beginning of this year 730 different American and Canadian amateurs have been logged.

The loud speaker artistic. The Sterling "Primax" model in statuette form.

MODULATION SIGNS.

It is suggested by a French amateur that the following signs should be used in describing the quality of modulation in telephony transmission: M1—Speech indistinguishable; M 2—Speech broken up; M 3—Voice clear; M 4—Speech clipped; M 5—Speech very clipped.

FURTHER NEW ZEALAND SUCCESSES.

Good reception of New Zealand amateurs is reported by Mr. J. Allen Cash (**2 GW**), of Lymm, Cheshire. The loudest station is **Z 4 AG**, which, states our correspondent, can be easily read all over the room on the loud speaker, with a two-valve (0—v—1) receiver. A twelve-wire counterpoise is used, with an aerial 65 ft. high.

Another amateur to receive the New Zealand stations with almost daily regularity is Mr. A. Acland, in the Chatham neighbourhood, who uses a single-valve set.

A claim to have heard a New Zealand station as early as October 9th is forwarded by Mr. A. L. Carrad, of Wembley, who states that he heard **Z 4 AK** working with a French station at 6.45 a.m.

Mr. J. H. D. Ridley (**5 NN**), of South Norwood, first heard **Z 4 AA**, **Z 4 AG**, **Z 4 AK** on October 20th at 6.42 a.m. On the 26th **Z 4 AA** reported **5 NN**'s

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signals as strong, but two-way communication was not effected owing to sunrise. **5 NN** employs a Meissner transmitting circuit, his receiver being a Burndept Ultra III, using detector and L.F. valves only. Mr. L. Heaton Armstrong, who has heard **Z 4 AA, Z 4 AG,** and **Z 4 AK,** reports that strongest signals are received from the first-named.

Working with **Z 4 AA** on October 30th, Mr. W. A. S. Batement (**G 6 TM**), was gratified to receive this message: – "You are the best station in G.B."

FRENCH PLEA FOR NEW RADIO REGULATIONS.

Wireless officers of the French Mercantile Marine are calling for an international radiotelegraphic conference on the use of wireless communication at sea, states our Paris correspondent. It is urged that the present regulations, formulated in 1914, have become obsolete owing to divergent national laws, and that complete revision is necessary.

METRONOME TUNING SIGNAL.

Instead of a tuning note, the Breslau broadcasting station uses a loud ticking metronome to enable listeners to tune in before the programme commences. It seems unlikely that this method can be as effective as the system used in this country.

CHINA'S NEW WIRELESS STATION.

The largest wireless station in China, and doubtless in the whole of the Far East, has just been installed at Shuang Chiao, near Pekin. Its construction has been carried out by the Mitsui Bussan Kaisha under a contract made with the Chinese Government as far back as 1918. The delay is accounted for by material and racial difficulties. Material for the masts was hard to obtain locally, and the original design had to be altered several times to meet the constant desire of the authorities to give China the best possible installation for the money expended. It is said that the new station successfully violates some of the preconceived theories of radio engineers.

DENMARK CENTRALISING WIRELESS ORGANISATION.

To prevent unproductive competition, the Danish Government is now grouping under one organisation the three chief wireless stations of the country. These stations, all State-owned, are:—the Naval radio station, hitherto under the control of the Shipping Department; the Lyngby Station, operated by the Posts and Telegraphs Department; and the Military Station at Ryvang. An additional station to be included under the central organisation will be that now under construction by the Navy near Copenhagen.

Wireless is now making great progress in Denmark, and the development of broadcasting is opening up a new market for all kinds of apparatus and accessories.

EXTRAORDINARY SWEDISH TRANSMISSION.

An astonishing report of reception of a Swedish amateur transmission reaches us from Mr. F. H. Tyler (**2 ASH**), of Kirby Muxloe.

On October 12th, Mr. Tyler heard **SMXX** testing on 60 metres, calling "**CQ** de **AGA** (Gotenburg)." A report was at once sent to the Swedish station, with the information that his signals were heard at R 6 strength on detector and 1 L.F. The reply came that on the occasion referred to **SMXX** was working with an indoor aerial and the counterpoise lying on the floor! The power input was not stated, but the antenna current was given as only 0·3 ampere.

If any other reader heard this transmission his report would be interesting. The owner of **SMXX** is Nils Eriesson c/o Aga Lux, Gotenburg, Sweden.

FRENCH 8 SSU.

The French transmitter **8 SSU** (Adjutant Bocquenet), desires English amateurs to know that his new address is 42e G nie, Bonn, R. Rhine. Rhenland. He has recently increased the power of his station to 50 watts, and is glad to answer all **QSL** cards.

HAVE YOU HEARD THE GONG?

When the Hamburg broadcasting station is about to commence its programme, a large brass gong is sounded. Two strokes on the gong announce an interval of two minutes, while another stroke signifies the beginning of a new piece.

We understand that an English news bulletin is broadcast nightly at 10.50 from the Hamburg station, which transmits on 387 metres.

AMERICAN AMATEURS AND SOLAR ECLIPSE.

An appeal to American amateurs to stand by during the solar eclipse of January 24th, 1925, appears in the November issue of the *Scientific American*. On that date the sun will be totally eclipsed over a large section of the U.S., extending from Cape Cod and Long Island to the northern boundary of Minnesota.

During the period of the eclipse a special effort is to be made to discover to what extent, if at all, wireless signals are influenced by the moon's shadow. American amateurs are asked to check the results obtained during the eclipse in California, last year, when the intensity of wireless signals increased, only to diminish in strength after the eclipse was over.

AMATEUR TRANSMITTING IN AUSTRIA.

Austria can now be added to the list of European countries which are just realising that the wireless amateur should be encouraged and not hindered. As a result of the new regulations, steps are being taken to form an Austrian Club for transmitting amateurs, and the organisers wish to have addresses of British amateurs willing to conduct tests with their members.

British transmitters with a knowledge of German or Esperanto who would like to be put into touch with Austrian fellow-amateurs, are requested to communicate with the Hon. Secretary, Internacia Radio-Asocio, 17 Chatsworth Road, London, E.5.

DO YOU HEAR ARGENTINE AMATEURS?

Amateurs who have received Argentine **CB 8** or any other Argentine amateur transmitters are requested to communicate with Mr. Adrian B. Jones, Gothic Cottage, Malvern Wells, Worcestershire, who is a representative of the Radio Club of Argentine.

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UNSOLVED PROBLEMS OF WIRELESS.*

By R. H. BARFIELD, M.Sc.

THE title of this article may be misleading, because I do not intend to discuss all the unsolved problems of wireless, but I am only going to deal with four, which are as follows:

(1) Why is long distance wireless possible at all?

(2) Why are signals stronger by night than by day?

(3) Why do direction finding stations experience large errors by night, while the errors by day are practically negligible?

(4) Why does the phenomenon known as fading occur?

These are the four problems which I wish to discuss.

Turning to the first problem I myself find it a very striking fact that although at present wireless communication is almost as common as line telegraphy, yet why it is possible at all must still be considered in the nature of a mystery. The reason for this can be shown by a diagram in a very simple manner (Fig. 1).

The question is whether a transmitter situated at London should be able to communicate by wireless with a receiver at New York. Theory informs us that in a homogeneous medium electromagnetic waves travel in a straight line. The straight line from London to New York (AB) passes through the opaque earth. The most favourable straight line for the waves to take woul be the line AC, tangent to the earth at London, and these waves would pass 3,000 miles above New York. Therefore there are obvious reasons why wireless waves would not be expected to be able to travel from London to New York.

When in contradiction to this, the possibility of long-distance wireless communication was definitely established an explanation for the fact was at once sought. At first three explanations were brought forward but they did not involve any new conceptions. They may be called the resistance explanation, the atmospheric explanation and the diffraction explanation. In the first case the argument was based on the well-known fact that the resistance of the earth causes the waves which are passing over the earth's surface to bend slightly forward. This bending can be shown to have an effect in causing the wireless waves to bend round the earth and so affords a possible explanation of the anomaly, but

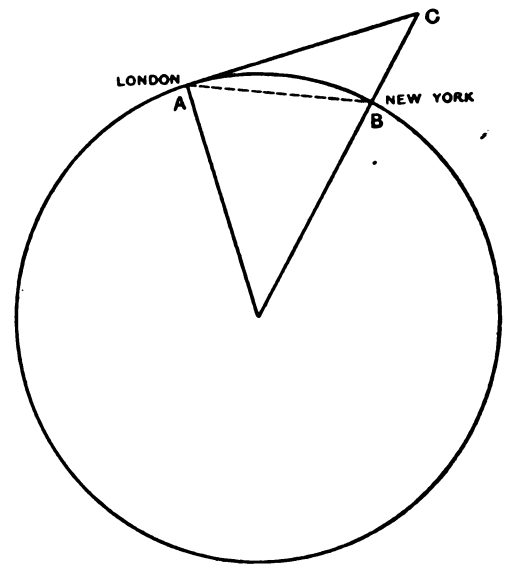

Fig. 1. A diagram which raises the question why a transmitter in London is heard in New York

when the problem was worked out mathematically and calculations made, it was shown that although there was some effect it was an entirely negligible one, and failed entirely to account for the observed results.

The second explanation, having thus dismissed the first one, is the atmospheric explanation, and it is suggested that since the atmosphere surrounding the earth is not

* A lecture delivered before the Radio Society of Great Britain at an Ordinary General Meeting held on October 22nd, 1924, at the Institution of Electrical Engineers.

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a homogeneous medium, the waves will not travel in a straight line. This lack of homogeneity is due, amongst other things, to the change in pressure which occurs with height. This change of pressure will produce a change in the dielectric constant so that the atmosphere will act as an optical lens and cause the waves to bend round the earth. But again, on attacking this problem in an analytical manner, it was possible to show that though the effect, did exist it could not by any means account for the strength of signals which are actually received over long distances.

The third explanation, which is the diffraction hypothesis, is much more difficult to dispose of. The argument here again is that we can only assume that the waves will travel in a straight line in a uniform medium. In the presence of an opaque body, electromagnetic waves are diffracted or bent. The earth may be considered as an opaque body placed in the path of the wireless waves and therefore we must expect some diffraction and bending of the light due to the presence of the body of the earth. Again, it was only possible to settle the question by mathematics. The problem was recognised as a very interesting one as soon as it arose, at the time when Marconi succeeded in spanning the Atlantic by wireless in 1902. Many mathematicians of first rank attacked the problem, which appears to have been a very abstruse one indeed, for it took no less than 15 years for a general agreement to be arrived at between these authorities. We may now say, however, that they have arrived at a practically unanimous agreement, and the verdict is that diffraction is entirely unable to account for the passage of waves around the earth. We are enabled to arrive at the extent of the discrepancy from their calculations. As an interesting example the measured intensity of signals at a receiving station at Darien from a transmitter at Nauen in Germany was found to be more than two million times as great as the theoretical value based on the diffraction theory. This is a very large discrepancy indeed, and thus we have a complete failure to account by known properties of the earth or of the surrounding atmosphere, for the phenomenon of long distance propagation and new hypotheses must be introduced to account for the effect.

Oliver Heaviside appears to have realised this very early, and to have dismissed the diffraction theory in his own mind without resort to mathematics. He suggested, as early as 1900, that there must be something in the upper atmosphere which accounts for the success of long distance wireless. He suggested the existence of a surface, concentric with the earth, at a height of about 100 km., which would reflect the waves back to earth again, thus enabling them to bend round the earth.

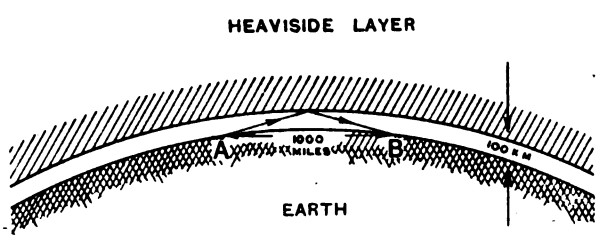

Fig. 2. Showing how the Heaviside Layer is supposed to act.

Fig. 2 provides a rough idea of how the Heaviside layer might be supposed to act. It will be seen that a wave travels from A to B, and it gets round the bend of the earth by being reflected from the upper layer. As to the nature of this layer it is supposed to consist of a highly ionised mass of attenuated atmosphere, this ionisation producing a degree of conductivity sufficient to give the layer its reflecting properties. The presence of such ions are strongly evidenced by other considerations of a meteorological nature. We are quite unable to account for the phenomenon of the Aurora without assuming the presence of an ionised upper atmosphere, and I also understand that the phenomenon of magnetic storms can be explained on the assumption of currents travelling in a conducting upper atmosphere. It is very difficult to criticise this theory of an upper layer, chiefly because it is at present only a nebulous speculation. It is interesting, however, to take the figures of Professor Watson, who calculated that assuming the layer had a height of 100 km., and had a conductivity about the

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same as dry earth, it would very well account for all the observed facts. This, of course, was at the time he made the calculation in 1918. Whether it would do so in the light of recent events it is difficult to say.

I find it rather difficult to conceive why this upper layer should have the sharply defined lower surface which is necessary to account for some of the phenomena. It is, however, the only plausible theory existing at present which has not been destroyed by argument, and it is supported by the fact that the other problems I am going to deal with seem to require solutions on very much the same lines.

The second problem deals with the increase of signals at night. This phenomenon is very well established. It must be familiar to all those who have experimented in any wireless reception, but it does not occur at very close ranges. It is also very much more marked on short waves than on long waves, and I understand that on the longest waves it is scarcely noticeable at all. Since the tendency now is to use shorter and shorter waves, it is natural that the phenomenon should have become more and more prominent and in the last year or so the most striking examples have occurred. I refer to the successful establishment of communication across the Atlantic by amateurs. These results provide very striking examples of the increase of signals after darkness.

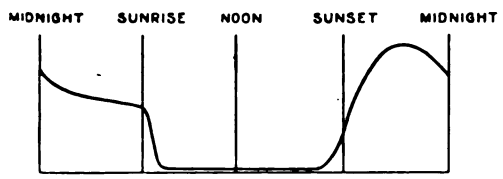

Fig. 3. A curve representing the measured intensity of short wave signals transmitted throughout 24 hours from Poldhu to America.

Fig. 3 shows how the signals increase as night comes on. It represents the measured intensities of the signals transmitted from the Marconi short wave station at Poldhu, and received in America. It is very striking to see how, during the daytime, the signals remain very weak, and how they increase at sunset and remain at a high value all night.

These examples I have given are taken from hundreds of others, and we must conclude that the phenomenon is a very fundamental one. The most interesting thing about these problems is the entire failure to find causes in the earth which can account for it. If we examine the factors near the surface of the earth which might influence the propagation of waves—which might hinder them in the daytime and help them at night—we cannot find any single agency which could give rise to the effects which are observed. Changes of conductivity of the atmosphere, changes in the very slight trace of ionisation present even in the lower atmosphere, changes of pressure, changes of temperature and changes of resistance on the ground surface, all these can be shown to have entirely negligible effects. It is impossible to associate with such changes which may occur in these factors, the very large and persistent effects of signals increasing at night. The inevitable conclusion then is that we cannot find a cause at or near the surface of the earth, and if we cannot find it in the explored regions of the atmosphere, we can only conclude that it must lie in the unexplored regions. If we admit that in the upper atmosphere lies the solution of the problem, then the waves which experience this phenomenon must have travelled through the upper atmosphere on their way to the receiver. If they have travelled through the upper atmosphere they must have been reflected down from it or bent down in some way in order to arrive again at the receiver. It is easy to understand how they can get up to the higher strata of the atmosphere, but to imagine them getting down again we must suppose some sort of reflecting layer. We are thus led back to the second problem, to the existence, presumably, of the Heaviside layer in some form or other. Unfortunately, an upper reflecting layer is not sufficient in itself to account for the fact that signals increase at night. An extremely plausible hypothesis has been formulated by Dr. Eccles, in which it is clearly shown how the change between day and night is produced. The phenomenon of increased signals at night does seem to necessitate the existence of some reflecting surface in the upper atmosphere.

The third problem is that of night effect experienced in wireless direction finding. All those who have had experience with direction finding apparatus are well aware that whereas by day wireless direction finders obtain a very high degree of accuracy,

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at night they are subject to large errors, and variable errors which occur at all sorts of irregular times and in a very irregular manner. The errors are known to amount in some cases to as much as 90 degrees, and may occur on any night. Fortunately for navigation, ships do not usually require to employ direction finding for a greater range than 100 miles, and within this range over sea the errors are practically never experienced. Like the phenomenon of increased signals, it is only experienced over comparatively long ranges.

In the course of this research conducted by Dr. Smith Rose under the direction of the Radio Research Board, curves were obtained showing the results of observations made on a direction finder at Bristol University over a period of 24 hours. The observations were made at several stations at a time, the transmitters being the German stations Nauen and Königswusterhausen, and three of the Marconi stations at Ongar in Essex. From these it was possible to see at a glance that during the day the errors are extremely small and are, in fact, practically negligible so far as direction finding purposes are concerned. Just before sunset, however, the errors commence, and they get greater and greater until a few hours after sunset, when they are very great indeed. Lasting all night until sunrise, they then disappear as mysteriously as they arose.

It was found from these investigations that direction finding errors were present on every wavelength investigated and very little difference could be detected between the various wavelengths. The fact that these curves have been selected from hundreds of others, is enough to show that this phenomenon is of a very fundamental nature.

Before discussing further this problem of the variation of wireless bearings at night I will turn to the fourth problem—that of the existence of fading. This phenomenon must also be very familiar to amateurs, and anyone who receives broadcasting stations over long ranges. It is a sudden dying away of signals, and again, only occurs at night over long ranges. Very little can be said about the nature of this phenomenon because it is so simple in its nature that there is not much to describe. It is a very striking thing, however, to hear signals suddenly fade right away and then burst out again as strong as they were before, but beyond the fact that t does occur, little is known about the laws which govern it.

I think there are many points which seem to show that these last two problems are due to the same cause. Thus, for instance, if fading is present, variation in directional bearings is also very likely to be experienced. Again, the important thing in my mind with regard to the phenomena is that once more we look in vain for variations of some property at or near the surface of the earth or in the lower atmosphere which may account for them. Once more, therefore, we are led to the conclusion that since we cannot find the cause in the lower strata of the atmosphere, it must lie in the upper unexplored portion. The lower regions of the atmosphere, I suppose, are well known up to heights of some 10 or 15 miles, so that it is beyond these heights that we must look for the solution.

In conclusion, I have dealt with four problems and the chief thing I have wished to show is, that they are definitely established as forming a fundamental part of the phenomenon of the propagation of wireless waves. In order to do so I sought to show the most effective examples of each of them. It was accordingly rather a surprise to me that in the last few days the most striking illustration of the first two of the problems should have come to light. I refer to the successful establishment of communication between England and New Zealand.

I have arrived at the conclusion that we can only hope to find a solution for these problems, by looking to the upper atmosphere. Each in turn has led to this conclusion. As to the nature of this surface in the upper air, the existence of which seems now almost definitely established, I must submit my opinion that we are still very much in the dark. I think there is a tremendous need for more data of an experimental nature. Each of these phenomena which I have described should be examined in as quantitative a manner as possible, and on as large a scale as possible. Only by doing this can we get sufficient information on which to formulate satisfactory theories. Meanwhile, of course, it is possible that, apart from wireless, those physicists interested in the structure of the earth may find a more direct means of examining the content of the upper atmosphere.

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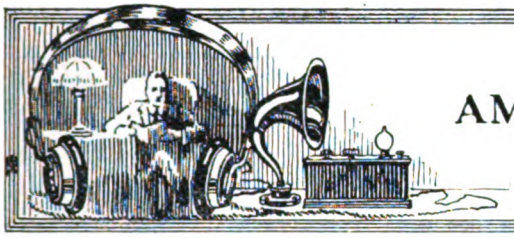

AMONG THE SOCIETIES.

How a knowledge of any of the other sciences can be very beneficial in the study of wireless was shown by Mr. A. E. Turville, lecturing before the Northampton Radio Society on Thursday, October 16th. The study of the laws of reflection of light served to explain in large measure the newly-introduced directional "beam" system of transmission, and the lecturer provided some interesting details of the experimental work proceeding at Poldhu.

* * * *

The reception of waves of the order of 5 to 10 metres was dealt with by Mr. Cole in an interesting lecture given before the Tottenham Wireless Society on October 15th. Mr. Cole's subject was "Short Waves," and in addition to his remarks on the ultra-short waves, the lecturer gave valuable information on 100-metre working, describing his own apparatus for this purpose and the results obtained.

The supersonic heterodyne also received attention and formed the subject of an informative discussion.

* * * *

At a recent meeting of the Kensington Radio Society, the President, Mr. J. H. Reeves, gave an enlightening discourse on "Fine Wire Coils." This was followed by a demonstration of the method of constructing formers and of winding coils.

* * * *

The subject of crystal reception, which has gained increased interest during the last few months, was dealt with in an interesting talk given by Mr. E. P. Bateman before the Southampton and District Radio Society on October 7th.

Mr. Bateman has been elected Hon. Secretary in place of Lt.-Col. M. D. Methven, O.B.E., resigned.

* * * *

At the second annual meeting of the Beckenham and District Radio Society, Mr. J. T. Butterfield resigned the position of Hon. Secretary, his successor being Mr. A. West.

The Society welcomes new members, and applications will be forwarded if addressed to the Editor of this journal.

* * * *

A monthly series of lectures on "Current Topics" has been instituted by the Borough of Tynemouth Radio and Scientific Society, the first lecture being given by Mr. Scott, who dealt first of all with wireless symbols.

He then spoke on high tensionless receivers, this being followed by a discussion on the "Beam" transmitter, which evoked considerable interest.

Radio Society of Great Britain.

T. AND R. NOTES.

A rather interesting discussion must arise out of the recent achievements of British amateurs as to which way signals travel round the world. It has been suggested that they proceed in the direction which is darkest, *i.e.*, via the American Continent. This does not explain why you can get a report from a U.S. amateur on the East Coast saying your signals are weak, when immediately afterwards you get in touch with a New Zealand amateur who states that your signals are too loud for the headphones. This was actually experienced by me several times. It has been suggested also that these signals travel *through* the earth. If the direction of our signals could be proved the results of these tests would be all the more valuable.

The reception of broadcast programmes is now permitted at stated times on board ship. Our photo shows the broadcast receiver on the s.s. "Perth."

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Amateurs will probably be wondering what has become of **Z 4 AK**, I enquired myself of **4 AG** and was told that **4 AK** is very busy trying to get a 250-watt tube to oscillate. I heard him start up once, but he soon collapsed.

A new-comer into the field is **2 AC**, who, though weak, puts out a good signal.

I would again ask British amateurs to keep above 90 metres so as to leave the field below free for distant DX. I have received reports from A.R.R.L. headquarters, requesting us to keep above 90 metres at all costs, as the disturbance below is terrific.

The Americans are now getting busy and can be heard and worked most mornings up to 0800 G.M.T. They are all on the look out for us, and the 4th district is particularly assertive, represented especially by our old friends of last year, *viz.*, **4 IO** and **4 FQ**.

The 4th district and 5th in Canada are going all out this winter to work us, but this will have to be after 0530 (G.M.T.) owing to difference in time.

Arrangements have been made with New Zealand amateurs to transmit from 5 p.m. to 7 p.m. every Sunday, as they are particularly keen to find out whether it is possible to communicate this way round, and I shall endeavour to see if permission can be obtained from the Postmaster-General for our amateurs to use increased power permits at 7 p.m., should anyone hear a New Zealander calling.

We still want more reports, and the reports so far received are most disappointing considering the excellent DX which has been done this last month.

Don't be put off by the cold mornings; get up and start the old set going and be rewarded by joining in what will prove to be one of the most wonderful years that radio amateurs have ever experienced, or can possibly ever experience, unless we succeed in hearing our signals returning round the world!

Remember, the Argentine amateurs have yet to be worked, also the Mexican, and this should be possible very soon. So keep a watch and remember that there are prizes offered this year.

Members of the A.R.R.L. have offered their heartiest congratulations to the British amateurs for their splendid achievement, in establishing two-way communication with N.Z. amateurs.

GERALD MARCUSE

(Hon. Secretary, Transmitter and Relay Section, Radio Society of Great Britain).

NEW SWEDISH TRANSMITTERS.

We have received the following list of new call signs allocated to Swedish amateur transmitters. This list supplements those which have already appeared in our issues of September 24th and October 8th.

SMYE	Uno Sammark, Skeppsbroplatson 1	Göteborg
SMYF	Nils Paul Renqvist, Villa Talltorp	Aby socken
SMYG	Nils Paul Renqvist, Drottninggatan 1	Norrköping
SMYH	Herbert Martensson, Rundelsgatan 27	Malmo
SMYI	Elof Jullander	Bofors
SMYJ	Gerhard Astrom	Bollnas
SMYK	Gustaf Berger, Bergdalen 3	Linkoping
SMYL	Nils Petersson, Söderslattsgatan 5	Trälleborg
SMYM	Erik B. and Gosta Nestius samt Nils Pichler	Trans Station
SMYN	Erik B. and Gösta Nestius samt Nils Pichler, Kvarteret Bullerbacken 8	Lidingön
SMYO	Erik B. and Gösta Nestius samt Nils Pichler, Kvarteret Stangslet	Appelviken
SMYP	Knut Hansson, Svartbacksgatan 28	Uppsala
SMYR	Bror Agren and Erik Sjöström, Soderslattsgatan 10 ..	Trälleborg
SMYS	Per Fritiof Gronlund ..	Leksand
SMYT	John Nordin	Finspong
SMYU	Bengt Welin, Adolf Fredriks Krykogata 9 B	Stockholm

WIRELESS IN CHILI.

In Chili public interest in broadcasting has grown to such an extent that although two years ago the country could boast of not more than half a dozen receiving sets, 6,000 receiving sets are now to be found in Santiago alone. A number of transmitting stations are already in existence and wireless dealers are reported to be doing exceptionally well.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 12th.

Radio Society of Great Britain. Informal Meeting. At 6 p.m. At the Institution of Electrical Engineers. Talk and demonstration on "A Dynamical Model of an Oscillating Circuit." By Mr. R. C. Clinker.

Radio Research Society, Peckham. At 44 Talfourd Road. Lecture: "Rectifiers." Discussion and Demonstration on "Transformer v. Resistance and Choke L.F. Coupling."

Streatham Radio Society. At 35 Streatham High Road, S.W. Lecture: "Valves." By Mr. W. P. Wilson.

Bristol and District Radio Society. Wireless Lecture No. 3. By Mr. W. A. Andrews, B.Sc.

Edinburgh and District Radio Society. At 8 p.m. At 117 George Street. Lecture: "Western Relay Conversion." By Mr. W. Winkler.

THURDSAY, NOVEMBER 13th.

Bournemouth and District Radio and Electrical Society. At 7 p.m. At Canford Hall, St. Peters Road. Experimental Night. Lecture: "C.W. Reception and Heterodynes." By Mr. W. A. Peters, B.Sc.

Derby Wireless Club. Lecture by Mr. A. T. Lee.

Luton Wirelers Society. At 8 p.m. At the Hitchin Road Boy's School. Experiments and Demonstration.

West London Wirelers and Experimental Association. At the Belmont Road Schools. Lecture: "Constructional Details, Part II." By Mr. J. F. Bruce.

FRIDAY, NOVEMBER 14th.

Bristol and District Radio Society. Demonstration and Address by Sterling Telephone Co., Ltd.

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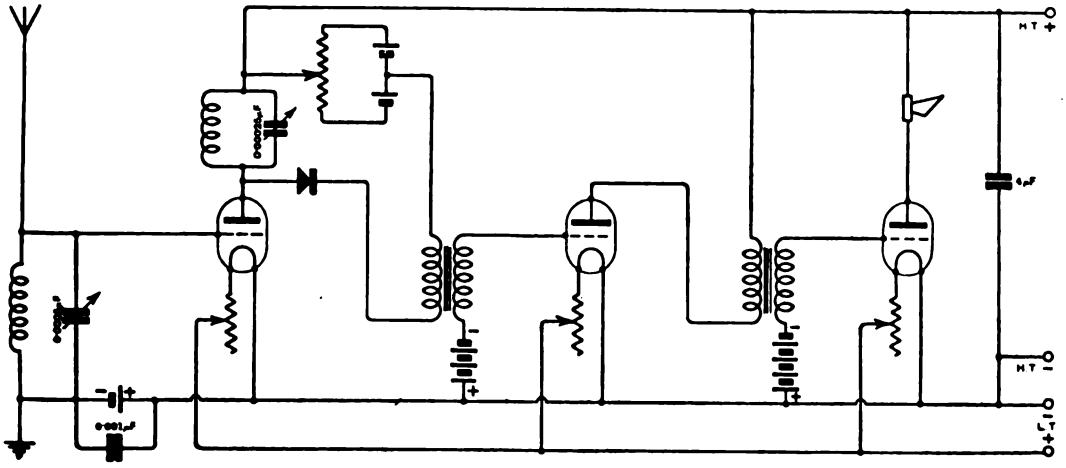
READERS PROBLEMS

Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

A THREE-VALVE RECEIVER FOR TELEPHONY.

A READER has asked for a design for a three or four-valve receiver suitable for the reception of telephony, with the minimum amount of distortion. A copy of the circuit diagram is reproduced below.

It was decided to use a carborundum crystal for rectification, as a detector valve working in conjunction with a grid condenser and leak is frequently a source of distortion, particularly in the case of very strong signals. Of course, it would be possible to utilise the lower bend of the grid voltage —anode current characteristic of the valve for rectification, without the use of a grid condenser and leak, but in most cases the curvature is not sufficiently sharp to give good results unless several stages of H.F. amplification are used to increase the amplitude applied between the grid and filament of the detector valve. In the case of the crystal rectifier, on the other hand, a series of crystals may be tried until one having a suitable characteristic is found. The carborundum steel detector is very reliable, and will give service for a long period without adjustment. In order to obtain an increased amplitude of signals for application to the crystal, a single stage of H.F. amplification is employed. A D.E. 5.B valve, which has a high amplification factor, will give very good results in this position. In order to ensure that no rectification shall take place in this valve, a grid battery of one or two cells should be connected, to prevent the flow of grid current. The aerial and grid coils could be coupled together, if necessary, to obtain reaction, but this measure should not be adopted unless absolutely necessary to obtain an adequate signal strength. If the receiver is situated near to the broadcasting station, and the volume of sound is unnecessarily large, it may be controlled by connecting a variable high resistance between the grid of the first valve and — L.T. This may decrease the selectivity of the aerial circuit and permit interference from other stations, since the anode circuit of the first valve is also highly damped by the resistance of the crystal detector. In this case the control resistance may be connected across the loud speaker or across one or other of the L.F. transformers. The latter method should not be used if the results obtained with the leak connected across the first valve are satisfactory, as the frequency characteristics of the transformers may be changed to a slight extent by connecting the resistance in parallel with one of the windings. For a similar reason it will be noticed that the usual by-pass condenser across the



A three-valve receiver for telephony.

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primary winding of the first transformer has been omitted. If a condenser is found to be necessary, its value should be very carefully chosen.

With the introduction of special L.F. transformers, such as the Marconiphone "Ideal" transformer, the L.F. valves may be transformer coupled without introducing any appreciable distortion, while the degree of amplification per stage, and the smaller H.T. battery necessary, form distinct advantages over the resistance-capacity method of coupling. It is important to use valves having characteristics specified by the makers of the transformers, in order to obtain distortionless results. If the first L.F. valve is a D.E. 5 and the second an L.S. 5, the first inter-valve transformer may have a ratio of 4 : 1 and the second a ratio of 6 : 1. An L.S. 5 type valve is recommended for the last stage, not by reason of the large volume of sound it is capable of delivering, but because a considerable portion of the straight part of the valve characteristic lies on the negative side of the zero grid bias line, and a fair degree of latitude is available before distortion can be caused by the curvature of the characteristic or by grid currents. An H.T. voltage of 120 volts may be applied to all three valves, and under these conditions a negative grid bias of 4·5 volts will be required for the D.E. 5 valve, and between 8 and 9 volts for the L.S. 5 valve.

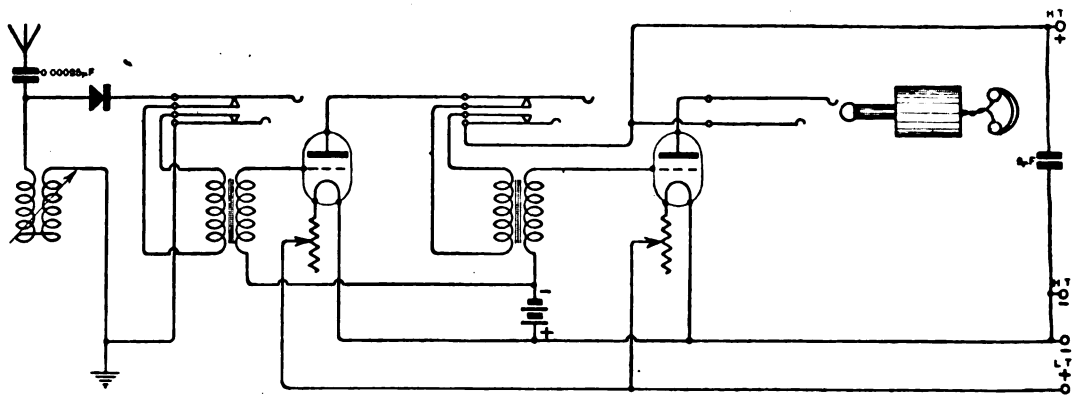
telephones may be used; while in the third telephone jack, with both valves inserted, a loud speaker may be used. As the same H.T. voltage is applied to both L.F. valves, a common grid bias battery may be used.

Relative Size of Aerial and Anode Tuning Coils.

THERE is no fixed relation between the sizes of coils used in the aerial and anode circuits of a receiver. The size of the anode coil can be fixed with a fair degree of accuracy, but the number of turns required in the aerial circuit will depend upon the dimensions of the aerial and the position of the aerial tuning condenser.

A reader has noticed a circuit in which the aerial coil is larger than the tuned anode coil, and asks if this is contrary to first principles.

It very rarely happens that the aerial coil is larger than the anode coil, and this relation can exist only when the effective capacity of the aerial circuit is less than the tuning capacity connected in parallel with the anode coil. When a series aerial tuning condenser is used, it is quite common to find that the same size of coil is required for both circuits. When the A.T.C. is connected in parallel, on the other hand, the aerial coil will be smaller than the anode coil. In the anode circuit, best results are obtained with a large coil and a small tuning capacity.



A crystal and two-valve receiver.

A Crystal and Two-Valve Receiver.

A DIAGRAM is given above of a wireless receiver suitable for use within a short distance of a broadcasting station. The aerial circuit is tuned by means of a variometer, and a fixed series condenser of 0·00025 μF. A crystal rectifier is used, and is followed by two stages of L.F. amplification.

The simplest method of switching a receiver of this type is to employ telephone jacks. With the telephone plug inserted in the first jack, good results will be obtained with a single pair of telephones. With the telephones in the second jack, and the valve switched on, three or four pairs of

Sources of Distortion.

MANY amateurs have found the difference in quality between resistance and transformer coupling so marked that they have decided definitely to abandon the latter method for the future. Before doing this they should make quite certain that the distortion is due to the coupling and not to the valves themselves. With transformer coupling the valves may have been overloaded owing to the high amplification per stage obtained with this method. On changing to resistance coupling, the variation of grid potential at each stage is reduced and amplitude distortion is minimised if not eliminated.

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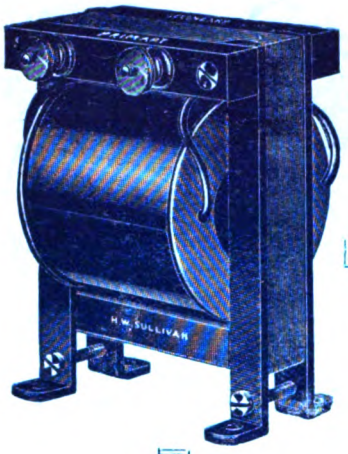

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INTERNATIONAL BROADCAST TESTS

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Barry.

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As the lease of our old premises recently expired, we decided to take the opportunity to move into more conveniently-planned premises, which will permit us to secure better facilities, both for our Repair Orders and also our regular Instrument work.

For some time past we found great difficulty in handling satisfactorily an increased volume of business in our old position, but we hope we have solved this problem by the new Laboratory we have planned and completed.

As soon as we have overcome the disorganisation due to moving our plant, we hope to place our Repair Orders upon pre-war delivery basis, when about five or six days was the time limit for all Repair Orders, with the exception of our very accurate Model 5 Laboratory Standard Instruments.

It was not easy to find premises sufficiently large for our Laboratory and within reasonable distance of our old position; but we succeeded finally in securing these at 15 Great Saffron Hill, which is our new address.

We are confident that this change will enable us to give our clients a much improved service, and at the same time we have secured better working conditions for our employees.

In order to avoid unnecessary trouble and delay, we would suggest that you make a special note of the change of address.

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ALL OUR RECEIVERS CARRY OUR GUARANTEE AGAINST FAULTY WORKMANSHIP.

Mr. D. GLOVER,
23 Collings Park,
Plymouth
and of Calcutta—writes:—

I have consistently received several American broadcast Concerts, particularly **WBZ**, Boston, Mass., and **KDKA** Pittsburgh, also **WJZ**. **The two former stations were distinctly audible on the loud speaker using only three valves.** Mr. Glover owns and uses a standard ABGAR receiver.

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

THE TRANSATLANTIC BROADCAST TESTS.

BEFORE another issue appears in print the Transatlantic Broadcast Tests will be under way. As we go to press the arrangements are practically complete and everything points to the probability of interesting results both as regards receiving American broadcasting in this country and the reception in America of the Continental as well as the British broadcasting transmissions.

It will have been observed from the programme outlined in our last issue that the tests, in addition to providing unusual facilities for British listeners to receive American broadcasting programmes, will also give a unique opportunity for the reception of the Continental broadcast stations when the B.B.C. stations will not be in operation and very little jamming is likely to be experienced.

We hope that there will be reasonable care taken by all those who listen-in so that whether receiving the Continental stations or the American broadcasting, there shall not be a storm of complaints afterwards of reception made impossible by oscillation.

The Continental stations will broadcast on their respective wavelengths from 4 a.m. to 5 a.m. G.M.T. on the mornings of the 24th, 26th, 28th and 29th November, whilst the American stations, including Canada and South America, will transmit to Europe from 3 a.m. to 4 a.m. G.M.T. each morning from November 24th to 30th inclusive. The British broadcasting stations, including **5 XX**, will transmit from 4 a.m. to 5 a.m. on the mornings of the 25th, 27th and 30th November.

When the first arrangements for the tests were being made, America asked that the Continental and British stations should work on every day of that week as a unit: each station operating on its respective wavelength. The present programme, however, has been arranged in deference to two obstacles which stood in the way of all stations operating together. First of all, a good deal of heterodyne interference takes place between some of the Continental stations and the stations of the B.B.C., whilst secondly, it was found difficult to arrange for providing the necessary staff for each station every day of the week at such an unusual hour. We shall look forward to receiving from our readers, as early as possible, reports giving details of their reception of the stations transmitting on the other side of the Atlantic, since the utmost interest will be taken in America in the records of reception of the different stations.

Similarly we shall welcome reports of reception in England of the various Continental stations during the times that they broadcast.

WHERE THE AMATEUR IS JUSTIFIED.

IN these days, when so many things are being said of the amateur which are either untrue or at the least are calculated to mislead public opinion, it is well to take an opportunity from time to time to point out some of the advantages which accrue from the establishment of an amateur organisation such as exists in this country.

There are, of course, many interests which are opposed to amateur activities, and this fact must be faced. How far there is justification for antagonism towards the amateur is another matter and one which we are disposed to think that history will decide in favour of the amateur. In the

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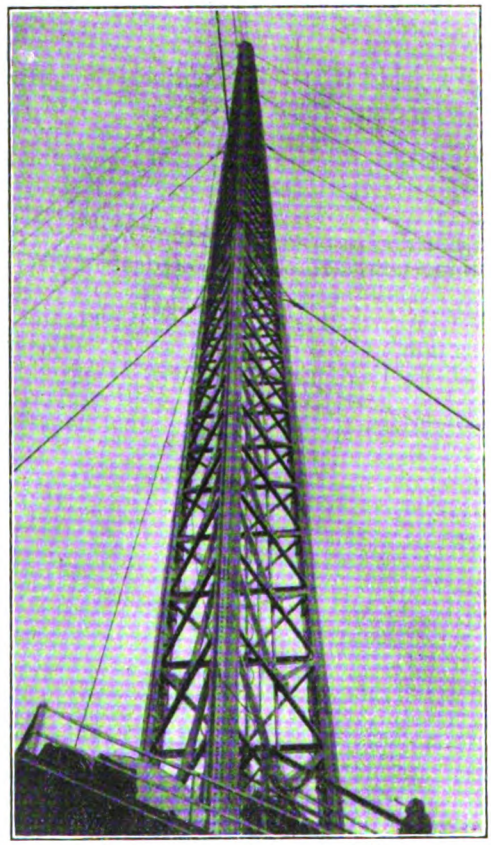
short record of broadcasting in this country opinions in some directions have already changed. We remember quite well that in the early days manufacturers of wireless apparatus believed that for wireless journals to advocate and facilitate the home construction of wireless sets was a policy extremely detrimental to their interests. Time has proved the fallacy of such a contention, for the home constructor has contributed very largely indeed to the prosperity of the industry and we doubt whether the wireless industry would have progressed to anything like its present proportions had not popular interest in what may be described as the "scientific hobby" side of the subject been cultivated. The fact, too, that the general public has been educated in wireless has made it almost impossible for unscrupulous dealers to traffic in "junk" apparatus. There is in this country absolutely no market for apparatus which falls short of reasonable expectations and if one cares to look for the reason it is that by education and by the increase in the numbers of comparatively skilled amateurs it is now impossible to impose upon the public. This circumstance in itself has been the means of avoiding the public disgust in wireless and broadcasting generally which otherwise might well have come about.



One of the eight giant masts for the aerial of the Rugby station which covers 800 *acres. The masts are of triangular steel construction, each weighing* 200 *tons and are* 820 *feet high.*

Thus far we refer only to typical examples of how the amateur has contributed towards the success of broadcasting and of the industry. We find examples of his usefulness still more obvious if we turn our attention to truly scientific fields. The amateur, as his very name implies, is not working for commercial interests, but for pure love of the science which he has selected as his hobby. Whatever successes he attains in the course of his amateur research work he is ready to announce them to the world for what they may be worth, either as definite advancements in the art or as data of value to other research workers as having some bearing on unsolved problems. Those enterprises on the other hand which are conducted for commercial objects do not in their own interests and in the interests of their proprietors or shareholders divulge to the world the steps by which they develop. These evolutions towards commercial perfection are closely guarded secrets in such enterprises and if commercial perfection is delayed, perhaps for years, the research work done towards that goal must never be disclosed until perfection is attained. The amateur is quite prepared, for example, to admit that he is not the first to realise the possibilities of short waves if satisfactory evidence is produced by others to support their claims, but the fact will yet remain that the amateur first gave his results to the scientific world and demonstrated in an indisputable manner the soundness of his conjectures.

The Services acknowledge the value of giving facilities for amateur work and development, and their opinion, we believe, should be enough to convince other parties who are inclined to show antagonism towards the amateur.

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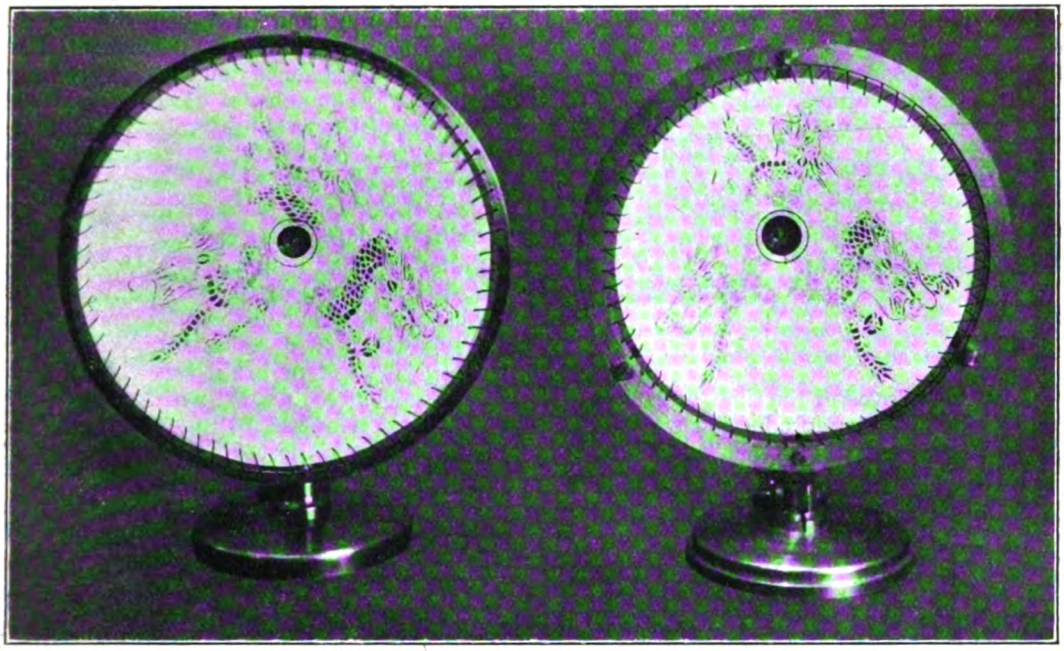

Fig. 1. Showing two of the loud speakers which are attractively finished.

A LOUD SPEAKER WITH A CONICAL PAPER DIAPHRAGM

The author describes the construction and performance of loud speakers having a conical paper diaphragm. Very good reproduction is obtained.

By G. W. SUTTON, B.Sc.

NOW that so many experimenters are turning their attention to the improvement of the quality of broadcast reception, the description of an easily constructed yet very satisfactory loud speaker may be of interest.

It is nearly two years since the idea of attaching a rigid paper cone to the reed of a telephone receiver (in place of the normal headphone diaphragm) was suggested to the writer. It at once appealed to him as a possible method of avoiding the resonance effects inseparable from the use of even a well-designed horn. Experiments with a pair of "A"-type Brown headphones led to the adoption of instruments of the type shown in the accompanying illustrations. When suspended from the ceiling of a small room these gave a pleasantly distributed volume of sound of what was then considered very satisfactory quality. The general dimensions of the cones may be gauged from the photographs, as neither the actual diameter nor the angle appear to be critical. The method of attaching the cones to the reeds used then, and in subsequent models, is to stamp out a small aluminium or copper cone, about $\frac{1}{2}$ in. in diameter, by means of two pieces of brass rod shaped as shown in Fig. 2. These cones are affixed to the paper by means of a few drops of thick shellac varnish, and to the reed by means of

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the small screws from the original Brown diaphragms.

A transformer coupled amplifier built of reliable components and carefully adjusted as regards anode voltage, mean grid potential,

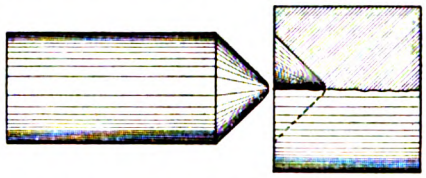

Fig. 2. Two pieces of brass rod suitably shaped are employed when stamping out the fixing cone.

etc., was employed at the time, and, although the quality of the reproduction was good at what may be described as "comfortable" volume, when further amplification was used for the benefit of visitors a certain unpleasant rattle appeared occasionally. It was thought that this was due to overloading these small receivers. As is well known, there are several inherent sources of distortion in the moving-iron telephone. Amongst these, mechanical resonance and the "double-frequency" component of the wave of attraction of the reed are probably the most important. The latter in particular is a possible source of trouble when the permanent magnets are small and the amplitude of vibration large.

Subsequently, however, choke coupling was used in place of the transformers with noticeable improvement in quality, and finally, when a resistance amplifier was installed, it was found that very considerable volume could be obtained without any trace of the previous rattle. In fact, it is possible to so overload these little receivers that speech can be heard and understood all over an eight-roomed house without undue unpleasantness of tone. Such results are only possible, in the writer's opinion, when a

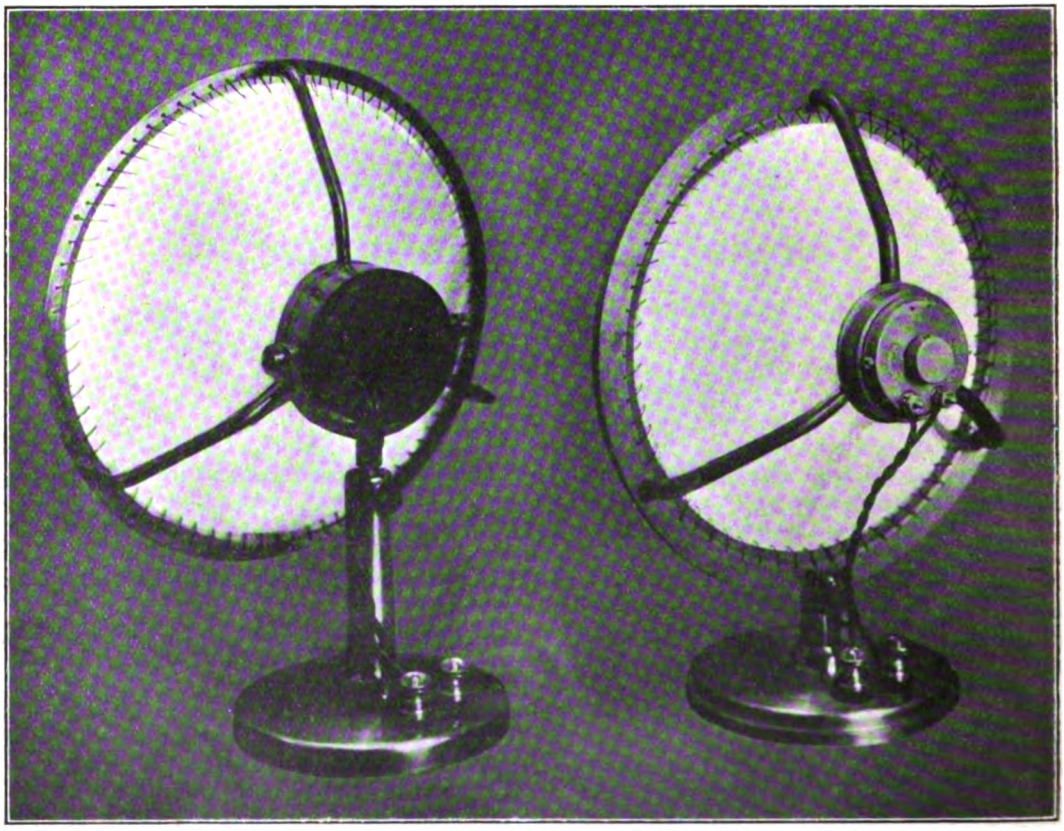

Fig. 3. Views of two of the author's loud speakers.

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correctly adjusted resistance coupled amplifier is employed.

The writer uses a perikon crystal detector, followed by a resistance amplifier of two or

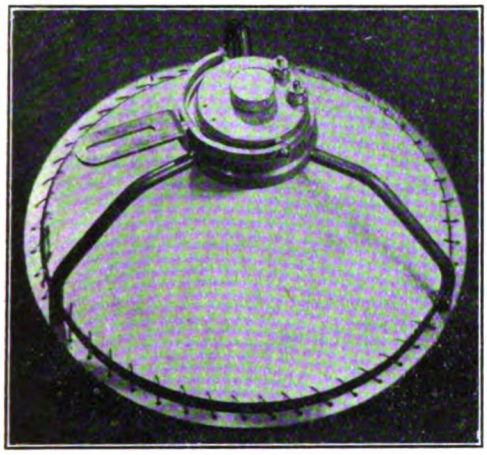

Fig. 4. A view of another loud speaker having a conical paper diaphragm.

three stages, depending upon the volume required. The anode resistances are made of No. 47 eureka wire, wound in 20,000 ohm sections, and arranged so that anything up to 80,000 ohms may be included in the anode circuits. The first two valves are D.E.R. type, and the third D.E.6. The mean grid potentials are adjusted to suit the H.T. voltages, and anode resistances used. On this set several standard loud speakers have been compared with those described above. The general impression received is that although horn type loud speakers are by no means as bad as there is a tendency to regard them, they all betray, in their reproduction, the fact that they *are* fitted with horns. The paper cone type, however, produces such natural results that the average person might readily mistake the reproduction for the original.

As regards volume, it is found that the standard type of instrument, of the larger sizes, is from twice to four times as efficient. This is not as important as it might appear to be, however, owing to the greater clarity of tone of the paper diaphragm type and the accommodating latitude of the human ear for different intensities.

The various constructional improvements which have been made to the original receivers are illustrated in the figures. Most important of these is the method of supporting the paper cones at the rim. The object of doing so is to maintain a truly conical form and consequently a maximum of rigidity. The edge of the paper is reinforced by pasting around it on the back surface a narrow strip of white silk which has been cut on the cross. This allows a thread of black silk twist to be used to lace the cone to the surrounding brass ring without tearing the paper.

Various thicknesses of paper have been used without much apparent effect upon the quality of the reproduction. The most satisfactory, taking everything into consideration, is a good stiff drawing paper.

The details of construction of the types illustrated in Figs 1, 3 and 4 can be gathered from the line drawings in Fig. 5.

An attempt was made to ascertain if one of the instruments, which was fitted with a very light paper diaphragm, had any prominent resonant frequencies. In ordinary telephone receivers these may be readily detected by the rapid change of inductance

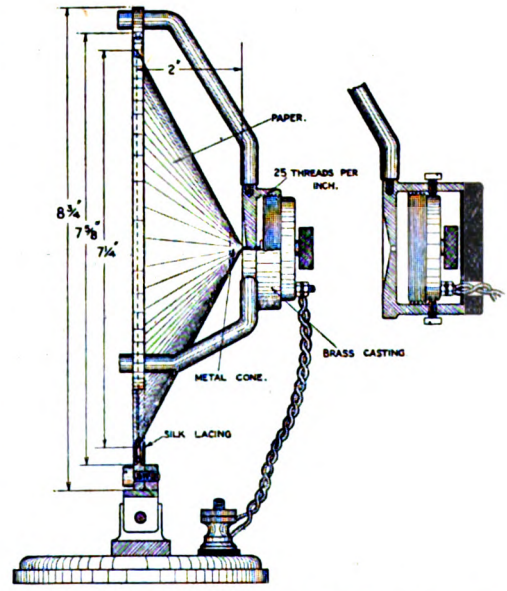

Fig. 5. Constructional details for a loud speaker having a conical paper diaphragm.

and effective resistance with frequency which takes place at these points. This is illustrated in Fig. 6, which shows the result

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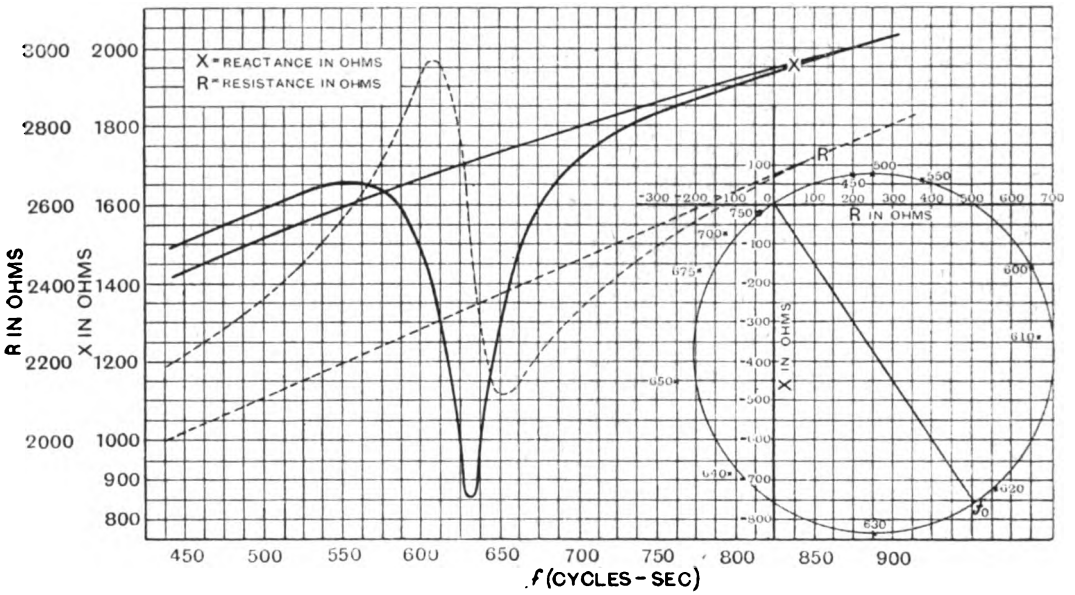
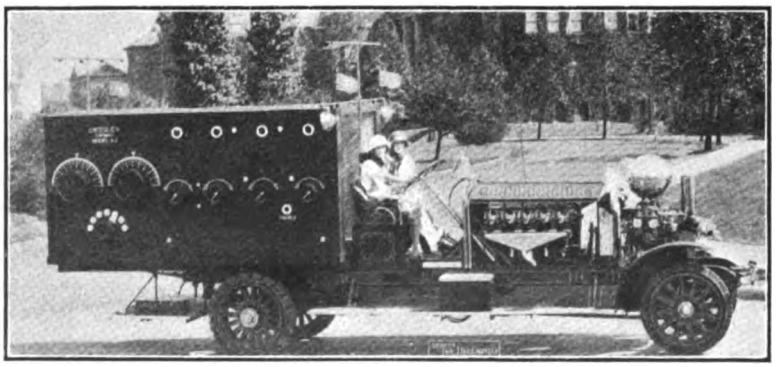


Fig. 6. The straight curves (two) show the variation of **R** *and* **X** *with frequency when there is no mechanical resonance. The other curves show the effect on* **R** *and* **X** *of resonance in the mechanical system of a receiver.*

of a test on a poor quality receiver. In the case of the paper cone loud speaker, however, no such change could be detected throughout a range of from 250 to 1,400 cycles per second. There may, of course, be one or more resonant points outside these values, or even a very heavily damped one within the range of the test, as the readings were not taken with any great accuracy. These would not be likely to cause appreciable distortion. The effect of such a resonant point as is indicated in Fig. 6, on the other hand, occurring as it does in the middle of the audible range of frequency, is very pronounced.

ADVERTISING WIRELESS.



This picture illustrates an advertising idea of a prominent American wireless company. Although this huge model of a Crossley receiver is only externally complete it carries within receiving equipment and loud speakers so that broadcasting can be received at any time to entertain the crowds attracted by the novel appearance of the outfit.

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A SENSITIVE REFLEX CIRCUIT.

The author discusses two well-known reflex circuits, and then describes a third circuit which he has developed.

By J. G. W. THOMPSON.

DURING the last year or so, the single valve and crystal reflex circuit has been very popular among experimenters.

The type of circuit usually favoured is that shown in Fig. 1. The valve here acts as both a high and low-frequency amplifier in the well-known manner, the low-frequency

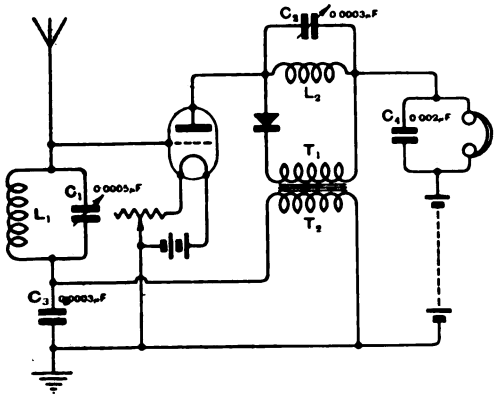

Fig. 1. A well-known one valve and crystal reflex receiver.

currents being fed back to the grid circuit by means of the L.F. intervalve transformer T_1 T_2. This type of circuit is too well known to need further description, and excellent results may be obtained from it. One of its greatest disadvantages, however, is the annoying "buzzing" so often produced when the set is brought to the oscillating point (by coupling L_1 and L_2), and which makes searching for weak signals a painful process.

A type of circuit which does not seem to have received the attention it deserves is that shown in Fig. 2, and is due to P. G. A. H. Voigt. The valve amplifies at H.F. and L.F. simultaneously, as before; coils L_2 and L_3 are the primary and secondary windings respectively of an H.F. transformer, the secondary being tightly coupled to the primary. The crystal ectifies the H.F. currents induced from the primary, and the resulting L.F. impulses pass *directly* back to the grid circuit for re-amplification. The difference between these two reflex arrangements lies chiefly in the method of feeding back the L.F. impulses. The Voigt method eliminates the iron-core transformer, this being replaced by an H.F. transformer.

Reaction may be introduced by coupling L_1 to L_2.

The circuit as shown is capable of giving very good results, the sensitivity to weak or moderate signals being about equal to a standard two-valve set—H.F. and detector.

The advantage of Fig. 2 over Fig. 1 is that the Fig. 2 circuit can oscillate quite quietly, with a very smooth reaction control, without the slightest low frequency "buzzing." In the writer's hands, it seems more sensitive to weak signals than the Fig. 1 circuit, and is still remarkably sensitive without any intentional reaction.

The purity of tone is exceptional, owing, no doubt, to the elimination of iron-cored transformers.

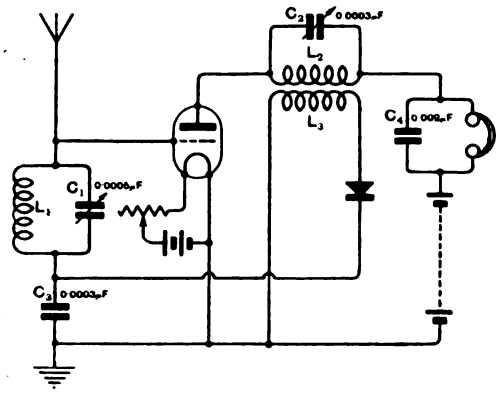

Fig. 2. A one valve and crystal reflex receiver described by P. G. A. H. Voigt.

For very loud signals (*e.g.*, the local B.B.C. station) the volume falls somewhat short of that given by Fig. 1, for reasons which need not be discussed here.

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To get the best results from Fig. 2, the following points should be noted.

1. Use the best components, particularly in the case of the crystal and detector mechanism.
2. Use a very fine and springy catwhisker; No. 36 gauge silver wire is recommended.
3. Plug-in transformers are not recommended. Use two low-capacity basket coils spaced about $\frac{1}{8}$ in. apart. For B.B.C. waves, 70 turns on each will cover from 300-500 metres with a 0·0003 mfd. variable condenser across the primary coil. The connections of the secondary coil should be reversed to see which way gives best results. One connection is much better than the other.
4. The crystal connections should be as follows: For weak or moderate signals, *crystal* to transformer secondary, *catwhisker* to top of C_3. For strong signals reverse above connections. A reversing switch is thus very convenient. The first way gives great sensitivity on weak signals and a very smooth reaction control, while the second way gives better results on strong signals, but if used on weak signals there is a pronounced "overlap" or "floppiness" in the reaction adjustment.
5. Various valves should be tried, as some "reflex" better than others. Dull emitters may very successfully be used.

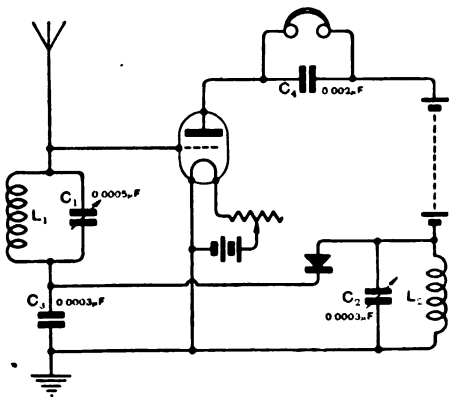

Fig. 3. This is a simpler circuit than that of Fig. 2, but the tuning changes when the telephones are handled.

Regarding results, the writer has clearly received all the main B.B.C. stations, several relay stations, and half-a-dozen or so of the continental stations on a small indoor aerial, but, of course, better results are given on a good outdoor one. (These results also apply to the circuit shown in Fig. 5.) As in most valve-crystal circuits, selectivity is not very high.

After about eight months' experimenting with various modifications of Fig. 2, the writer tried to simplify the circuit and eliminate the two coils L_2 L_3, it being desired to substitute for them a single (tuned) plug-in coil. The first, and most obvious, method is shown in Fig. 3. This worked, but since the high tension battery and telephones are at a high frequency potential to earth, tuning is completely upset when the phones are handled.

The next attempt is shown in Fig. 4. Condenser C_5 is to insulate the crystal from the H.T. supply, and although this circuit worked, results were not satisfactory.,

The final circuit is given in Fig. 5, and has proved very effective in practice.

Coil L_3 is a radio-frequency choke of about 250 turns, and of low self capacity. The H.F. potentials from the anode energise the tuned circuit L_2 C_2 via C_4, which latter is to prevent the H.T. passing through 'phones L_3 and L_2. C_4 may have almost any capacity, 0·0003μF. being quite satisfactory. For longer waves than about 600 metres, it may be advisable to increase this somewhat, and of course L_3 will need to be larger—say up to 750 or 1,000 turns.

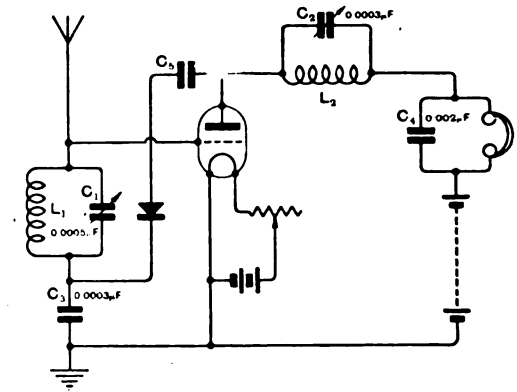

Fig. 4. This circuit is an improvement over that of Fig. 3.

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Reaction is obtained by coupling L_1 and L_2 in a two-coil holder.

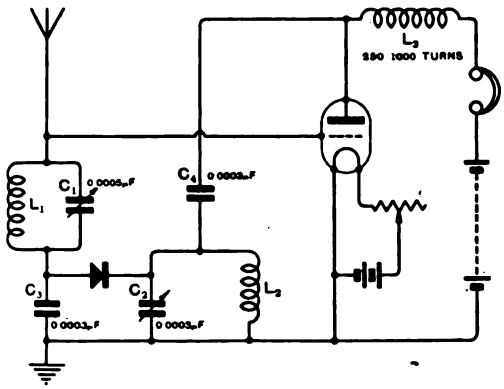


Fig. 5. A practical reflex receiver which can strongly be recommended.

A telephone condenser is now unnecessary, as the telephones are not in an H.F. circuit.

Results are equal to those given by Fig. 2, but the writer thinks the selectivity is slightly less.

The Fig. 5 circuit was suggested to the writer by the Reinartz circuit, and if C_4 is made variable, vernier reaction control may be obtained.

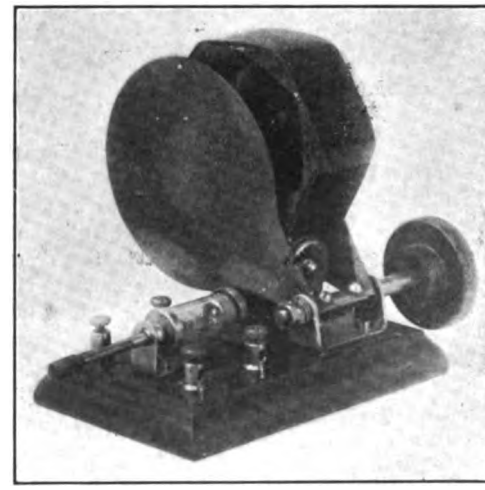
In concluding, the writer can strongly recommend the circuits of either Fig. 2 or Fig. 5, where sensitivity to weak signals, delightfully easy handling, and great purity of tone is required, but where the strongest possible signals from the local station are wanted, the circuit of Fig. 1 will give better results.

NEW APPLIANCES.

The Lissen Crystal Receiver.

IT has been the practice of manufacturers in the past to model their crystal receiving sets on one of three tuning principles. The tuning circuit has consisted either of a fixed inductance tuned with a series or parallel variable condenser, or a variometer tuner, and sometimes a coil tapped off at both ten and single turns. This latest product of the Lissen Company makes use of a coil of the plug-in type, suitable either for the wavelength ranges of the broadcasting and relay stations using say a 50-coil, while when it is desired to receive the transmissions from **5 XX** a 200-coil can be inserted.

Tuning is effected by altering the position of a pair of damping plates with regard to the turns of the inductance. It is well known that the inductance of a coil is reduced when a metal plate is brought against the winding and thus by carefully controlling the position of the tuning plates on this set, signals can be critically tuned in. The performance of this set is particularly good and signal strength is equal to that obtained by the best of any of the other tuning systems. It was thought perhaps with the tuning plates completely covering the coil that signal strength might perhaps be reduced, but tests were made using a variable condenser in the aerial circuit so that a particular transmission could be brought in with various positions of the tuning plate and results showed that signal strength was equally good on all adjustments.



Lissen's new crystal set.

An interesting feature of this set is that the entire base is made of moulded material and all the necessary holes are made in the process of moulding. The wiring up is also

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worthy of note inasmuch as stamped connectors of suitable shapes are dropped over the various terminals and screws as the components are assembled.

The outfit has a very good appearance and is a durable job, not likely to get out of order by constant use. The Lissen Company have every reason to be proud of their latest product.

Moulded Parts.

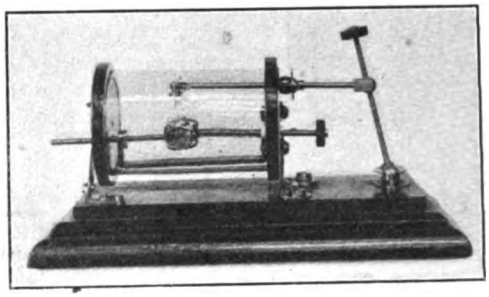
The variometer formers shown in the accompanying illustration afford good evidence of the progress which has been made in the production of intricate mouldings in insulated material. They are products of the Crystalite Manufacturing Co., Ltd., Tonbridge, Kent, and possess a good clean finish.

Moulded variometer formers.

"Aermast" Stay and Halyard Wire.

The needs of the amateur as regards aerial wire have been fully met by the manufacturer and there is a vast variety of types of wire all specially designed for aerial construction purposes. It is rather surprising that in the past little or no effort has been made to put out a special wire suitable for the construction of guy wires and halyards. The wire which one may purchase is usually too heavy or too difficult to handle.

A specimen of stranded wire specially made up for guying small masts has come to hand. It is strong and light and can be easily bent round insulators, masts and eyespikes. Made of stranded steel wire, it is heavily galvanised to protect it from the corrosive action of the weather and is of ample strength for ordinary amateur purposes, having a breaking strain of about half a ton. The complete stranded cable is equal in size to about No. 15 S.W.G., so it is quite inconspicuous and 100 feet of it weighs only 14 ozs. The wire is of such temper that it is easy to handle and will not unwind when cut, provided that it is bent back sharply beforehand.



A useful crystal detector in which provision is made for using almost the entire surface of the crystal

A New Crystal Detector.

There are two requirements in crystal detector design. Firstly, the crystal must be so mounted that it can be moved to permit of the wire point making contact with any part of its surface and secondly, that the pressure between the crystal and wire point must be capable of critical adjustment.

The form of crystal detector construction shown in the accompanying photograph provides for the crystal being rotated and also propelled from side to side. An ingenious point in design is that the arm operating the wire can be swung about to search out good points on the crystal, whilst a vertical thread gives that very necessary fine adjustment of pressure. This interesting detector is a product of the Star Rotary Crystal Detector Co., of Manchester.

The Brandes Table-Talker.

The Brandes Company are well known as manufacturers of high grade telephone receivers, and it is with interest that we learn they are now devoting their attention to the production of a loud speaker. This is well designed from an acoustic standpoint and gives good clarity with reality.

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A HOLDER FOR PLUG-IN COILS.

H. M. DENISON.

The author describes a holder for plug-in coils which is inexpensive and easily constructed.

IT is surprising how few experimenters construct components (apart from tuning coils) which are employed in their receiver. One piece of apparatus in particular which is considered difficult to make is a holder for plug-in coils, yet it is quite an easy matter to construct an effective coil-holder.

The holder described here is of the two-coil type, and the moving holder is operated through a 3 to 1 reduction gear.

The materials required are :—Two ebonite coil plugs ½ in. in thickness ; piece of ¼ in. ebonite about 3 ins. by 3½ ins. ; 4 ins. of ¼ in. square brass rod ; meccano cog-wheel 1½ ins. dia. (57 teeth) ; meccano pinion ½ in. dia. (19 teeth) ; ebonite knob tapped 2 B.A. ; about 6 in. of 3/16 in. round brass rod, and a few screws and washers.

The moving coil plug is first mounted on an axle, as in Fig. 1. A hole 5/32 in. diameter is drilled right through the plug, ⅜ in. from the bottom edge and tapped 2 B.A. Two pieces of 3/16 in. round brass rod of lengths 1 in. and 1⅜ in., are then cut, and each is screwed with a 2 B.A. thread

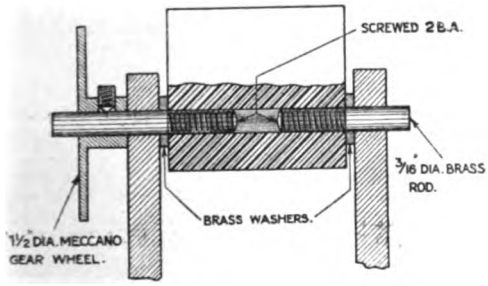

Fig. 1. A part sectional view showing the method of mounting the moving coil holder.

for ½ in. of their length from one end. These are then screwed up tight, one into each end of the tapped hole through the ebonite plug, as in Fig. 1.

Two pieces of ¼ in. square brass rod each 1¾ ins. in length are then obtained.

Two holes, 3/16 in. diameter are then drilled through each, one being ⅜ in. from one end, as in Fig. 1, and one ⅜ in. from the other end as in Fig. 2. One end of each piece of rod is then filed up flat and square, and a hole drilled for ⅛ in. or so up the centre of each and tapped 4 B.A.

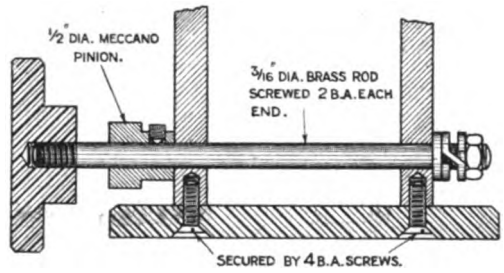

Fig. 2. Showing the method of attaching the pillars to the base, and the position of the pinion wheel and the knob.

The breadth of the ebonite plug, with a brass washer slipped over the brass axle on either side, is determined, and two holes of diameter sufficient to allow a 4 B.A. screw to slip through, are then drilled the above distance (plus ¼ in.) apart in the ebonite baseboard, about 1 in. from the edge, 3 ins. in length. Each arm of the axle is then passed through the top hole of each of the brass pillars, which are then secured to the baseboard by means of two 4 B.A. countersunk screws passing through the holes just drilled, as in Fig. 2. The coil plug should then swivel smoothly between the two brass pillars.

Another piece of 3/16 in. diameter round brass rod about 3½ ins. in length is then cut, and screwed for ⅜ in. at each end with a 2 B.A. thread. This is then slipped through the two bottom holes in the brass pillars, as in Fig. 2. A brass washer and a spring washer are slipped over one end and a 2 B.A. nut screwed on as in Figs. 2 and 4. A meccano cog-wheel 1½ ins. diameter (57 teeth) is then slipped over the longer

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brass arm, and screwed tight with a set screw as "A," Fig. 4. It may be found necessary slightly to enlarge the centre hole. A meccano ½ in. pinion (19 teeth) is also obtained, the centre hole slightly enlarged if necessary, and slipped on the rod as at "B" Fig. 4, and screwed up tight with a set-screw. An ordinary ebonite knob is then screwed on the rod on the same end as the pinion, the nut at the other end being adjusted to permit an even and smooth rotary action of the knob. The coil-holder will then appear as in Fig. 4. To ensure a good engagement between the gear wheels, it may be found necessary to put a washer between the wheel "A" and the brass pillar.

A plug for the fixed coil is then fitted to the base. A small block of ebonite is obtained (wood will do as well) of the same breadth and thickness as the coil plug, generally ½ in. by 1⅜ ins., and of height 1 in. Two holes 3/16 in. diameter are drilled vertically upward through this, and ¾ in. apart.

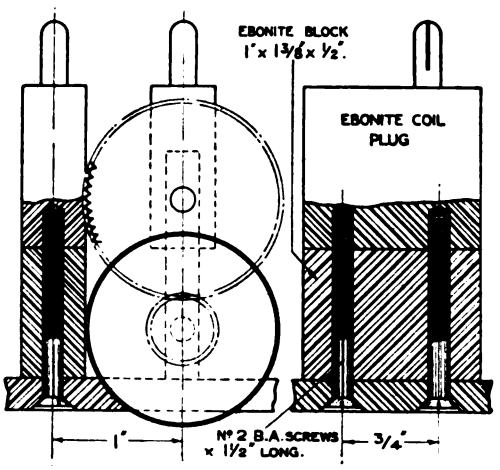

Fig. 3. The construction of the fixed holder.

Two holes are also drilled through the coil plug for ½ in. approximately, being ¾ in. apart and 5/32 in. diameter and tapped with a 2 B.A. thread. The ebonite base is drilled with two 3/16 in. holes ¾ in. apart and 1in. from the two holes securing the brass pillars, and countersunk on the underside. Two 2 B.A. brass screws 1½ ins. in length are then passed up through the base and through the ebonite block and screwed tightly into the coil plug so as to secure it firmly to the base as in Fig. 3. The coil-holder is then complete in assembly, and may be touched up, the edges of the base being bevelled off with a file.

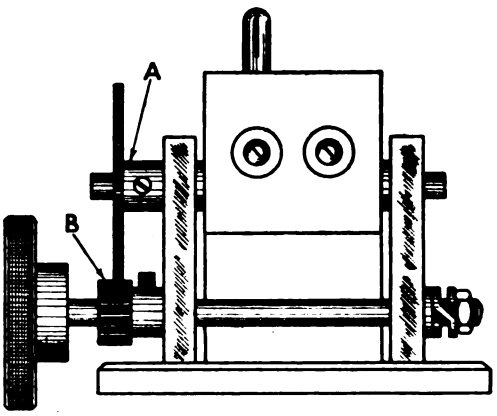

Fig. 4. A view of the movable holder.

If a three-way holder is required, it is quite an easy matter to fix another moving element similar to the first, and on the opposite side of the fixed plug.

This little device will be found easy to make, and an exceedingly smooth and fine adjustment can be obtained with just a little care in the fitting of the components.

KDKA.

FOURTH ANNIVERSARY OF FAMOUS AMERICAN BROADCASTING STATION

November 2nd was celebrated as the fourth anniversary of **KDKA**, the pioneer broadcasting station of the Westinghouse Electric and Manufacturing Co., at Pittsburg, Pa, U.S.A. The first programme transmitted by this famous station was devoted to broadcasting the voting results which resulted in the election of the late Mr. Warren Harding as President of the United States. The early transmissions under the call sign **8 XS** were of an experimental nature, and were conducted from the home of Mr. Frank Conrad of Wilkinsburg, Pa., and it was not until November 21st, 1920, that **KDKA** found its present home. Technical improvements were rapid, and indeed still are, for the engineers claim that the station has never been more than three months old!

Programme novelties have always been a feature of **KDKA**'s transmissions, and this station is stated to have been the first to broadcast news, time signals, sporting events, church services and bedtime stories.

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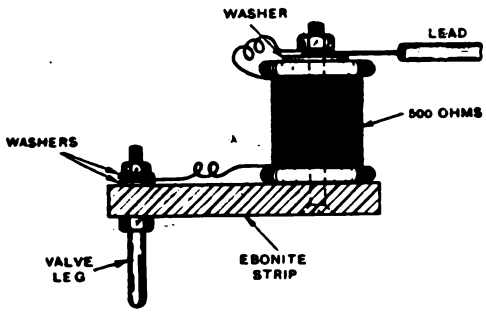
READERS' PRACTICAL IDEAS.

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Protecting the H.T. Battery.

THE fitting of a resistance in the H.T. positive lead is rapidly becoming a standard practice. With a resistance of about 500 ohms so connected, the danger of damaging the battery by short circuiting



A spool of resistance wire connected in the H.T. battery lead to prevent short circuits.

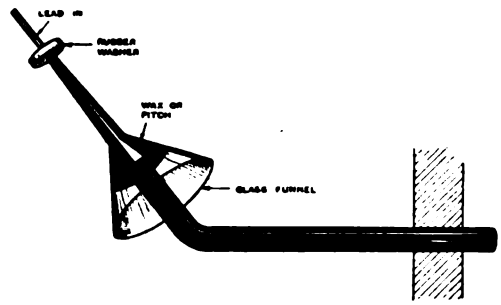
is eliminated, whilst the burning out of valve filaments by accidental contact with the H.T. supply is entirely avoided. It is essential, however, when using a device of this sort to arrange for a 2 mfd. bridging condenser to be connected across the H.T. terminals of the receiving instrument. Such a protecting resistance is simple to make up* and a suitable design is shown here.

E. G. N.

Improving the Lead-in.

THE conventional form of leading-in insulator consisting of an ebonite tube with brass rod and nuts, suffers from the serious defect that in wet weather its insulation may fall to a very low value owing to the short leakage path. To overcome this defect the insulator should be fitted with a "shed" which not only extends the distance over which leakage can occur but protects a portion of the insulator from moisture.

A simple design is shown in the accompanying diagram and can be cheaply made up from a piece of ½-in. ebonite tube about 18 ins. in length, a glass filter funnel 4 ins. in diameter, a small quantity of wax or pitch and a rubber tap-washer. To bend the tube to the shape shown it should be immersed in boiling water and the bend is made 6 ins. from one end at an angle of about 130 degs. The tube should then be inserted in the funnel and sealed in with melted pitch of a depth of about 1 in. The aerial



A glass funnel can be usefully employed for increasing the leakage path on the leading-in insulator.

lead-in is threaded through the stem of the funnel and the ebonite tube and to prevent moisture creeping in at the junction between

* A suitable bobbin already wound can be obtained for a modest sum from Messrs. Woolworths, who have branches in various parts of this country.

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the aerial wire and the glass stem a tap-washer should be slipped over. If rubber cable of a suitable size is used for the lead-in this washer will not be needed as the insulation can be made to fit tightly. The insulator is mounted in the window frame by making it a good friction fit.

E. J. S.

Making an Aerial Mast.

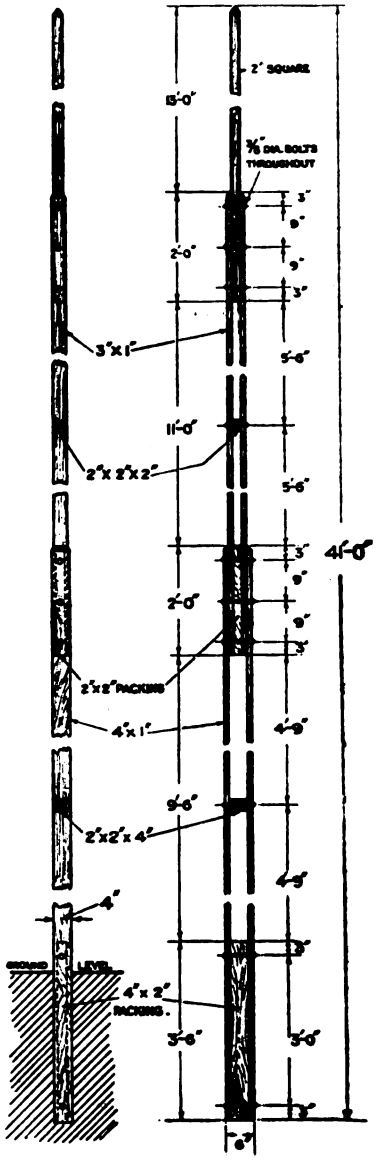
THE drawing, which includes all the necessary dimensions for a 41-ft. mast, presents an arrangement possessing both good appearance and low cost. The necessary timber (which should of course be reasonably free from knots) and bolts can be purchased for about 10s. which is probably less than half the cost of a pole of the same length. When erected the mast looks quite well with stay wires secured to the points where the joints are made in the timbers. At least one coat of paint is essential and the buried portion should have two coats or perhaps better, a liberal treatment with tar or creosote.

E. M. T.

Shielding Variable Condensers from Dust.

A VARIABLE condenser can easily be rendered dust-proof and the time spent in making up a cover is probably little more than that required to thoroughly clean the vanes.

Procure some thin celluloid and cut a strip equal in width to the depth of the condenser and long enough to completely surround it with an overlap say of ¼ in. Temporarily clip the ends together with paper clips to form a cylinder. Now roughly cut two circular end pieces and allow plenty of overlap. Holes should be made in these pieces to clear spindle terminals, etc., and can be cut with a good sharp penknife. A small quantity of celluloid cement will be needed to hold the pieces together and can be made up by dissolving thin strips of celluloid in acetone. The celluloid will take some time to dissolve. The open side of the cylinder can now be cemented down and the end pieces fixed in position. The acetone will evaporate rapidly, leaving the celluloid white, but upon complete drying will again become transparent. If any difficulty is found in making a good job of the end pieces then it is advisable to securely attach small portions of the end pieces at a time, using the cement sparingly, having made a good job of the cylinder first. When thoroughly dry the projecting edges of the end pieces can be removed with sharp scissors.



Constructional details of a timber-built mast.

Cement made with acetone shrinks on drying but possesses much more rapid drying properties than when amyl acetate is employed as a solvent. An acetone solution,

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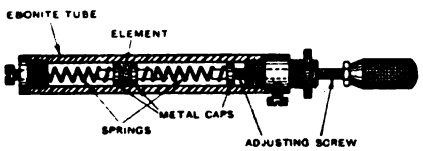
of celluloid makes a good insulating varnish and has many wireless uses.

J. B.

Another Suggested Variable Grid Leak.

SUITABLE constructional details are given though this idea is principally put forward as a suggested method of producing a substance capable of giving various resistance values. The variable resistance element is mounted so that it can be compressed by means of a screw and spring and it consists of a small piece of sponge thoroughly impreganted with indian ink and allowed to dry. As pressure is applied the area of the sponge in contact increases, giving a drop in the resistance value. Such a resistance has been in use for some three months and has been found to be quite durable, giving reliable resistance values between one and ten megohms. Various ranges of resistance may be obtained by using larger or smaller resistance elements.



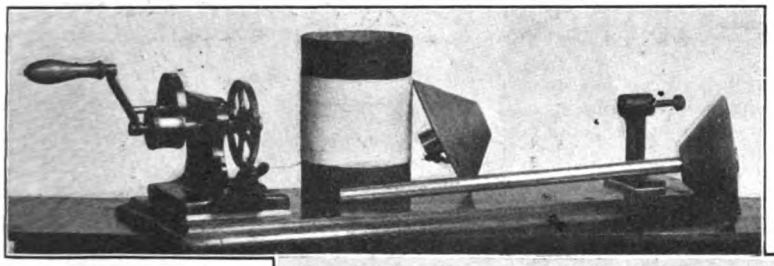
Constructional details of a reliable variable high resistance.

G. S.

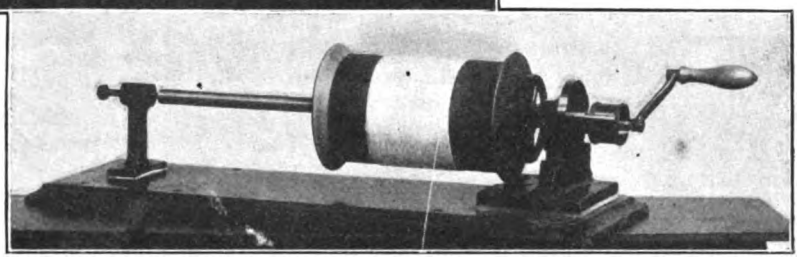
A Cylindrical Inductance Winder.

TO wind a cylindrical inductance, in the absence of a lathe, is not an easy task. Not possessing a lathe, a remedy was found in the use of an old type of cinematograph projector. Remove the whole of the upper portion of the mechanism with a hack-saw, merely leaving the base with the crank and the flywheel, which is geared up relatively to the crank, in the ratio of 1 : 8. This flywheel provides a very nice steadying action whilst winding a coil. A mandrel was then constructed from a piece of ¾ in. steel tubing. One end fits on the boss of the large gear wheel, the other end being plugged and centred for the tail stock. This tube is fitted with two large 90° cones, one of which is fixed, and the other is adjustable longitudinally. Between these cones the tube is centred automatically, and with a very sure grip. The little machine will accommodate any tube from two to twelve inches long and from two to six inches in diameter, thus covering any possible requirement. The wire is fed to the machine from the reel, passing on its way through a friction grip composed of two pieces of cork. This friction is about three feet away from the machine. Keeping the wire tight, a coil can be wound very quickly, the adjacent coils being in contact and in perfect lay.

A. C. B.



Coil winder constructed from cinematograph parts.



Formers of various sizes can be accommodated between the cones and single layer coils rapidly wound.

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A COMBINED BUZZER WAVEMETER, WAVE-TRAP AND CRYSTAL RECEIVER: 300 TO 700 METRES.

The buzzer wavemeter is one of the most useful instruments of an experimenter's equipment. Its use in the design and calibration of inductance coils and condensers often saves a considerable amount of time and calculation.

By J. G. MACVIE.

THE accompanying photographs and figures illustrate a compact and portable wavemeter, which was constructed from parts in the writer's possession. The fact that the finished instrument will also function as a popular form of wave-trap, and even as a simple crystal receiver will no doubt recommend it to those who desire an accurate though inexpensive piece of apparatus.

The containing box, which was originally used for storing film negatives (and may be purchased at any photographic dealers), is 4½ ins. deep, 3¾ ins. wide, and 5⅜ ins. long, internal measurements, while the lid is ⅞in. deep. The original yellow varnish was removed with sandpaper, the box stained and polished, and fitted with a leather carrying strap of good quality. All the components are mounted on an ebonite panel which fits flush with the top of the box, and rests on narrow wooden strips glued to the inner side of the box. The actual lay-out of the panel will be clear from the photographs and Fig. 2.

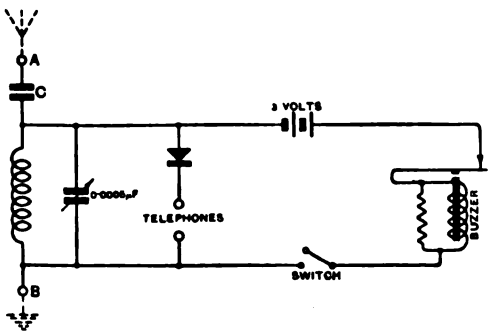
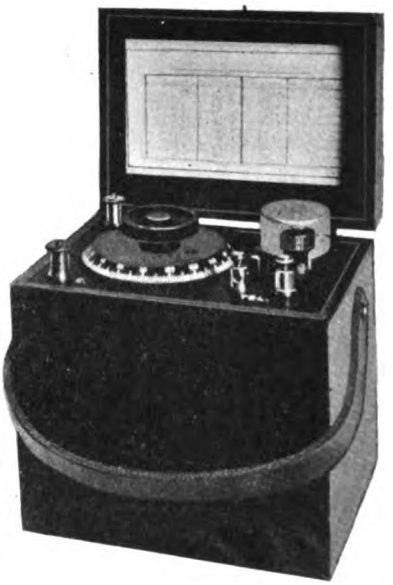


Fig. 1. The connections of the instrument.



The complete instrument.

The variable condenser is of 0·0005 microfarad capacity, and although one of the square law type would perhaps be preferable, a standard condenser of the ordinary type has proved satisfactory.

A honeycomb coil having 75 turns of No. 24 D.C.C. wire wound on a 1½ in. former (with eleven spokes on each side) is employed as the tuning coil. The winding is given a coat of thin shellac, and clamped between two ebonite discs, which are held on an extension of the condenser, as indicated in Fig. 3. In order to leave room for the wiring of the switch, crystal detector, and telephone terminals, a narrow ebonite platform, supported on two short legs of No. 2 B.A. rod, is used to carry the buzzer and battery. The buzzer is of the high note type, and its windings are shunted by a non-inductive resistance. The shunt in this instrument consists of 12 ft. of No. 36 enamelled Eureka wire. The buzzer is excited from a 3-volt flash-lamp dry cell battery, which is held to the platform by means of a length of ½ in. brass strip.

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The crystal detector to be employed should be one with small dimensions, in order that it may fit on the top of the panel, and will permit the lid of the instrument to be closed down. An unusual type of detector is employed in the instrument illustrated, but one of usual construction with a crystal and wire contact will give satisfactory results.

From the connections given in Fig. 1, it will be seen that the coil and condenser are connected in parallel. Across the tuned circuit is the crystal detector and telephone terminals, and also the buzzer, buzzer battery and switch. When the instrument is to be used to receive signals, a pair of high-resistance telephones (2,000-4,000 ohms) are connected to the telephone terminals, and the switch is put to the " off " position.

To use the instrument as a generator of oscillations the telephones should be removed, and the switch put to the " on " position. The buzzer then excites the tuned circuit which radiates oscillations of wavelength determined by the constants of the circuit and the setting of the variable condenser.

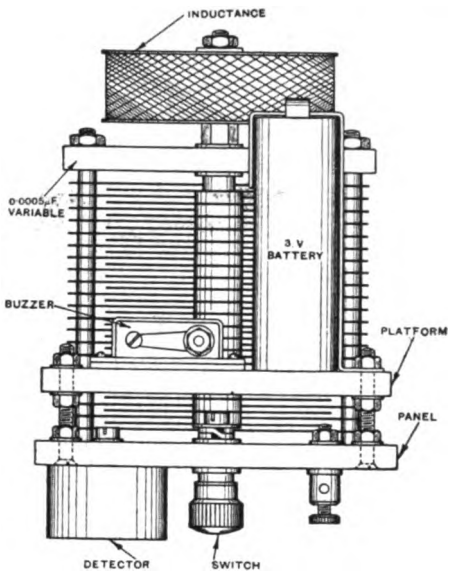

Fig. 3. An end view showing the method of fixing the battery, buzzer, tuning condenser and tuning coil.

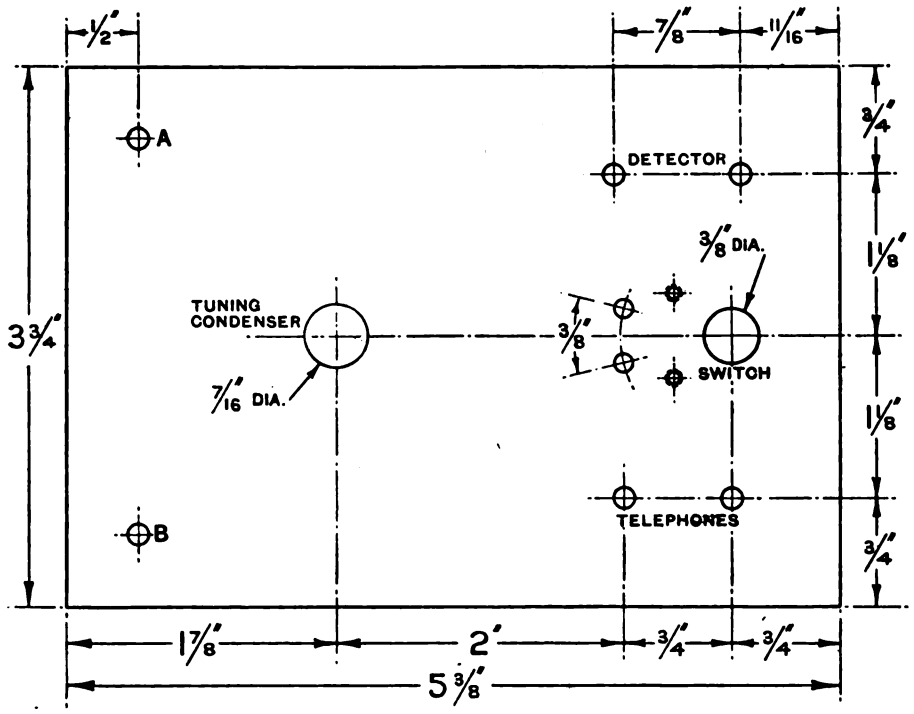

Fig. 2. Lay-out of the components on the ebonite panel.

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When the instrument is to be used as a crystal receiver the aerial and earth should be connected to the terminals marked A and B respectively. It will be noticed that a fixed condenser C is connected between the aerial terminal and the tuned circuit. This fixed condenser may have a capacity of about 0·0001 microfarads. The setting of the tuning condenser for a given wavelength when the instrument is employed as a crystal receiver is only a little higher than when it is employed as a wavemeter.

Those who find that a simple tuned circuit performs satisfactorily as a wavetrap will be able to employ this instrument by connecting to the A and B terminals, removing the telephones from the telephone terminals and putting the switch in the "off" position.

Fig. 4. A view of the instrument which shows the arrangement of the components.

AN INDIRECT METHOD OF DETERMINING THE GRID CHARACTERISTIC.

While the determination of the anode characteristic of a valve is a fairly simple matter to the possessor of a milliammeter, the determination of the grid characteristic involves the use of a microammeter, an instrument which few experimenters possess. An indirect method of determining the grid characteristic is therefore of interest.

By M. E. JANMOULLE, A.C.G.I., B.Sc.

THE circuit which is used is shown in Fig. 1 and does not differ materially from that usually employed for determining the anode characteristic, except for the provision of a grid leak and short-circuiting switch in the grid circuit.

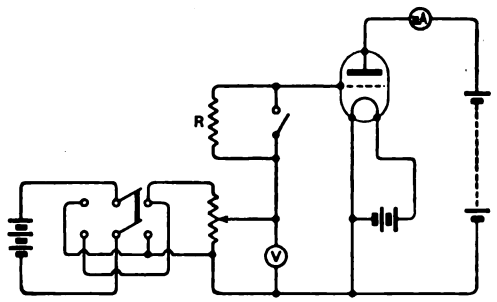

Fig. 1. The circuit arrangement for determining the grid characteristic.

The filament current and plate voltage need not be known, but both must be kept constant throughout the test.

Variable grid potentials may be applied to the grid either directly or through the grid leak by means of a potentiometer, reversing switch and grid battery, and may be read off on a low-reading voltmeter V.

The anode current may be measured by means of a milliammeter mA included in the anode circuit.

The value of the grid leak should be accurately known; it would perhaps be best to obtain one of reliable make, and to have it measured by the makers. Failing that, a Wheatstone bridge or a low-voltage insulation tester may be used to measure the resistance of the grid leak used.

The anode characteristic is first taken in the usual way, the grid leak being short-circuited. A series of grid potentials are

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applied to the grid, and the corresponding values of the anode current noted. A curve is then plotted showing the relation between grid potential and plate current (curve 1, Fig. 2).

The grid leak is then inserted and the relation between the potential of the lower end of the grid leak and anode current found in a similar manner. The results are plotted on the same sheet (curve 2, Fig. 2).

It will be noted that the two curves differ considerably in shape. The grid characteristic may be derived from these curves in the following manner.

Consider two points A and B on curves 1 and 2 respectively such that the plate

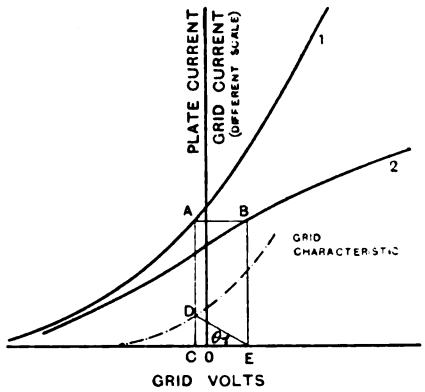

Fig. 2. Showing the method of obtaining points for the grid characteristic curve.

current is the same. The grid potential which corresponds to that current is obviously OC, hence the potential of the top or grid end of the grid leak corresponding to point B must also be OC. Since the potential of the lower end is OE, it follows that CE is the drop of potential along the grid leak due to the grid current flowing in it. The latter may therefore be found by dividing CE expressed in volts by the resistance R of the grid leak.

This current may then be set off along CA at any convenient scale, and the grid characteristic is found by joining a series of points determined in this way.

A more convenient way of doing this is to set off a line ED from E such that $\tan\theta = \frac{1}{R}$, due consideration being given to the scales of grid current and grid potential.

The point of intersection of ED with AC will give the required point on the grid characteristic. The complete characteristic is found as previously by joining a series of points.

The proof of the latter construction follows immediately from the geometry of triangle DCE:

$$DC = CE \times \tan\theta$$
$$= CE \times \frac{1}{R}$$

but CE = voltage drop along resistance $R = V$, hence: $DC = \frac{V}{R}$ = current in R = grid current.

This method is naturally not so accurate as the direct method, but gives quite good results provided the grid leak is accurately known. Even when the grid leak cannot be measured at all, by giving it an arbitrary value, the *shape* of the grid characteristic can be determined, which in some cases is sufficient to find the best values of grid potential to suit the operating conditions of the valve.

THE FREE STATE AMATEUR.

Comment on the slow development of wireless in the Irish Free State was made by Mr. G. M. Harris, President of the Radio Association of Ireland, at a meeting in Dublin on October 7th. Although, he said, Irish wireless amateurs paid higher licence fees than were demanded in any other country, they were prohibited from experimental transmission and were left with no alternative but to listen in to what other people provided and paid for.

Mr. Bradley proposed that the Association should strongly condemn the attitude adopted by the Irish Post Office towards amateur wireless work in general, and Mr. Callaghan, seconding, said that the time had come when licences should be granted for amateurs to participate in the Trans-atlantic tests. The original motion having been withdrawn the following resolution was finally passed :—

"That this Association disapproves most strongly of the lack of support and the absence of facility given by the Postmaster-General of Saorstat Eireann to the development of amateur wireless communication in the Free State. It considers it most unfair and unjust to impose the present fee for wireless reception, and strongly urges that a broadcasting scheme be at once undertaken and completed."

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PATENTS AND ABSTRACTS

A Regenerative Receiver.

Reaction effects are usually obtained by magnetic coupling between the anode and grid circuits, or by connecting a small variable condenser between the anode and grid of the valve. Unless the values of the components have been carefully chosen, there is usually difficulty in obtaining close adjustments. It is claimed (see Patent No. 222,595) that it is easier to make the desired adjustments by employing the circuit of Fig. 1.

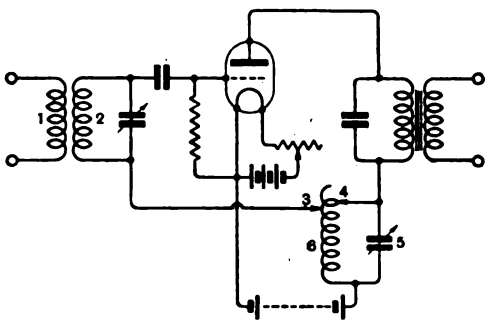

Fig. 1. Connections of a regenerative receiver having a tuned anode circuit. One end of the secondary circuit is connected to the anode circuit.

The ends of the coil 1 may be connected to the aerial and earth in the usual manner, and the secondary circuit, 2, comprises the coil and tuning condenser. The end of circuit 2 does not, however, connect direct with the filament, but is joined to a contact, 3, on coil 6, which is in the anode circuit. The anode circuit contains an intervalve transformer (or telephones), the tuned circuit 5-6, and the anode battery.

In order to obtain regeneration, it is desirable that the different tuned circuits be in resonance with the incoming signal, and for that purpose the tuned circuit 5-6 is tapped, the portion of coil 6 in circuit being determined by the position of contact 4.

The operation of the circuit is somewhat as follows: incoming signals are tuned by adjusting circuit 2, and setting up amplified voltages across circuit 5-6, joined to the anode of the valve. As circuit 2 is connected by contact 3 to coil 6, the amplified voltages in coil 6 affect the grid circuit, and are such as to assist the currents already flowing in the grid circuit. The degree of reaction may be varied by altering the position of contact 3 on the coil.

High Frequency Amplification.

In most receivers employing tuned intervalve high frequency couplings good results are obtained as regards selectivity and signal strength, but there is the disadvantage that it is difficult to tune in a signal whose wavelength is not accurately known. A further difficulty arises in connection with the provision of reaction to give effect both on the aerial and anode circuits.

With the object of removing these disadvantages, the arrangement of Fig. 2 has been devised and is described in Patent No. 222,562. It will be seen that three valves are employed. The first valve V_1 operates

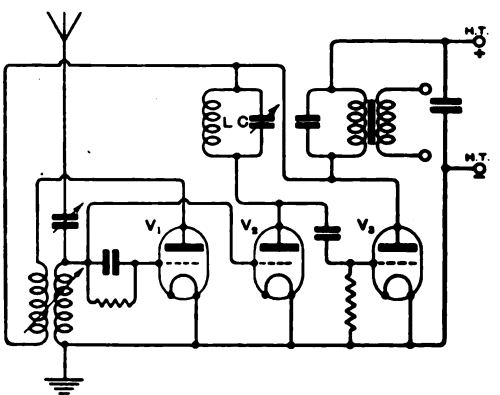

Fig. 2. A special method of connecting three valves to give ease of operation, and selectivity.

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as a rectifier, and has a reaction coil connected in its anode circuit. The second valve, V_2, is also connected to the aerial, and includes in its anode circuit a tuned circuit, L-C. There is also a third valve, V_3, the grid of which is connected to the anode of the second valve through a condenser. The anode of the third valve is connected to the low potential end of the reaction coil, and to one end of the primary winding of an output or telephone transformer, or to telephones.

The method of using this circuit is as follows :—

If it is desired to receive a station whose wavelength is not accurately known, the filaments of the valves V_2 and V_3 are switched off, and the valve V_1 is used. When the station has been found, in order to introduce the tuned high frequency amplification, all that is necessary is to complete the filament circuits of (valve V_2, with its associated detector valve V_3).

An important point is that no switching of any high frequency portion of the circuit is necessary. When these valves are turned on, it will be found that whatever the tuning of the anode circuit, the signal as received on the stand-by arrangement will not be lost, although it will be slightly weaker, owing to the extra loading of the grid of the valve V_2. All that is then necessary is to tune the circuit L-C, until either the system oscillates or an increase of signal strength is noted.

The question as to whether the receiver will oscillate when L-C is brought into tune with the aerial circuit depends largely upon the ratio of C/L in the tuned anode circuit. If this ratio is large, the signal will be increased without oscillation commencing. If the ratio is small, immediately the two circuits come in tune, the receiver will for the moment oscillate. To stop this the coupling between the reaction coil and the aerial coil may be weakened slightly.

Simplified Tuning.

In the construction of a wireless receiver which is to be highly selective, it has been found advisable to provide at least three separate adjustments by which the operator can tune the receiving circuits to the desired wavelength. These three adjustments, for example, might comprise the following: (1) an adjustment to tune the aerial; (2) to tune the secondary or grid circuit of a valve; and (3) to tune the anode circuit of this valve.

A receiving set with three such adjustments is difficult to operate, as it is obvious that one operator cannot make these three adjustments simultaneously. Accordingly, the Western Electric Company (Patent No. 221,868) have designed a receiver in which the knobs for making two or more adjustments are so associated with each other that the actuation of one knob will cause movement of the knobs controlling one or more of the other adjustments.

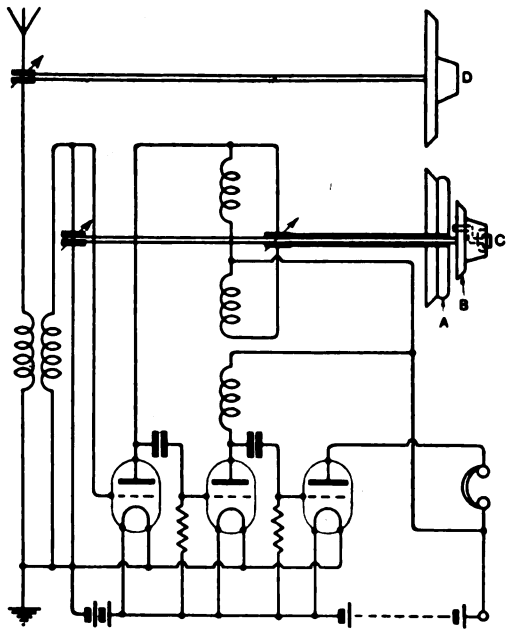

Fig. 3. A three-valve receiver having three tuned circuits arranged for easy operation.

This is effected by providing a small bolt, which may be moved to lock the knobs together. One arrangement is shown in Fig. 3, where the grid and anode circuits are tuned by variable condensers, the condensers being operated by knobs A and B.

When it is required to tune the set to any desired wavelength, bolt C is depressed, and the two knobs, D and A actuated until the signals to be received are heard in the receiver. To obtain a fine adjustment, the bolt C is withdrawn from knob A, and knobs A and B are then operated separately until the signal is heard with the greatest strength.

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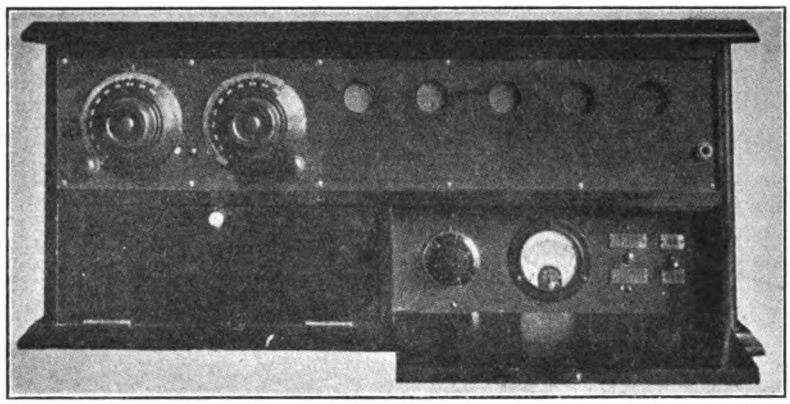
THE SUPER-HETERODYNE RECEIVER

AN ACCOUNT OF ITS ORIGIN, DEVELOPMENT AND SOME RECENT IMPROVEMENTS.*



THE invention of the super-heterodyne dates back to the early part of 1918. After much experimental work an eight-valve set was constructed, consisting of a rectifier, a separate heterodyne oscillator, three intermediate frequency amplifiers, the second rectifier and two low frequency stages. The intermediate frequency stages were coupled by tuned aircore transformers adjusted for a frequency of about 100,000 cycles, with an adjustment for controlling the regeneration. The amplification of voltage measured at the input of the second detector with the amplifier just below the oscillating point was equivalent to a radio-frequency amplification of 500.

The arrangement of this circuit is given in Fig. 1. It gave satisfactory results, except that the inclusion of a regenerative control on the intermediate frequency amplifier made skilled handling necessary, as the adjustment of the frequency of the oscillator changed the plate current of the detector valve, and this in turn varied the resistance which that valve introduced into the amplifier and upset the regenerative adjustment.

For the purpose of determining the results which can be obtained by pushing the method of super-heterodyne reception to the limit, a resistance-coupled intermediate frequency amplifier consisting of five valves having a high amplification factor was constructed.

The voltage amplification of the five stages was probably between 5,000 and 10,000 fold.

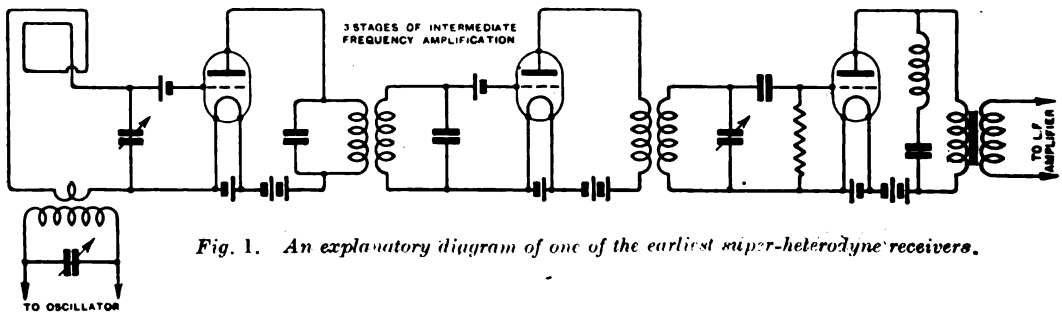


Fig. 1. An explanatory diagram of one of the earliest super-heterodyne receivers.

* Described by Edwin H. Armstrong in a paper read before the Institute of Radio Engineers, New York, March 5th, 1924.

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While greater amplification could have been obtained, the sensitivity of a set composed of a two-valve frequency converter, a five-valve intermediate frequency amplifier, a detector, and one stage of note magnification was such that on a 3-ft. loop, the sole criterion of reception was simply whether the signal was stronger than the atmospheric disturbances.

With the coming of broadcasting, and with the increase in the number of stations and the consequent interference, the super-heterodyne began to take on a new importance, an importance which was based not on its superior sensitivity nor on its selectivity, but on the great promise which the method offered in simplicity of operation. This solution lay in the construction of an intermediate frequency amplifier which would amplify a given frequency, and a band 5,000 cycles above and below it, and which would cut off sharply on either side of this

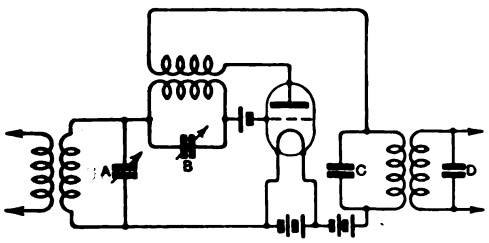

Fig. 2. One arrangement in which the valve performs a double function.

desired band. To determine just what could be accomplished on these lines, a set giving the maximum usable sensitivity and selectivity was constructed. A high frequency stage (untuned transformer), a rectifier, an oscillator, a three-stage iron core transformer-coupled intermediate frequency amplifier, designed to cover a band of 20,000 to 30,000 cycles, a second detector, and two stages of low frequency amplification were employed. The receiver is shown (without the low-frequency amplifier) in the accompanying illustrations.

To prevent the intermediate frequency amplifier from oscillating each stage was shielded. The use of a high frequency stage before the first detector possesses the advantage that the reaction coil may be coupled with the detector valve circuit instead of the frame aerial circuit. The results obtained with this receiver were as follows. On a 3-ft. frame aerial, the factor determining the reception of the station was solely whether the signal strength was above the level of the atmospherics. The selectivity was such that stations which had never been heard before on account of interference from local stations were received without a trace of interference. While the performance of the set was much superior to any other receiver, the cost of production and maintenance was prohibitive.

It has been apparent ever since the question of the application of the super-heterodyne to broadcasting has been considered, that there were too many valves performing a single function which were quite capable of performing a double one. The most outstanding example is that of the separate heterodyne oscillator. Two tuned circuits were therefore connected to the oscillator, comprising a simple circuit tuned to the frequency of the incoming signal, and a regenerative circuit adjusted to oscillate at such a frequency that the second harmonic of this frequency, beating with the incoming frequency, produced the desired intermediate frequency. The circuit is shown in Fig. 2.

Referring to this diagram, circuit A is tuned to the incoming signal, circuit B is tuned to one-half the incoming frequency, plus or minus one-half the intermediate frequency, and circuits C and D are both tuned to the intermediate frequency. The operation of the system is similar to ordinary self-heterodyne action.

By reason of the asymmetrical action of the valve, there are created in the circuits a

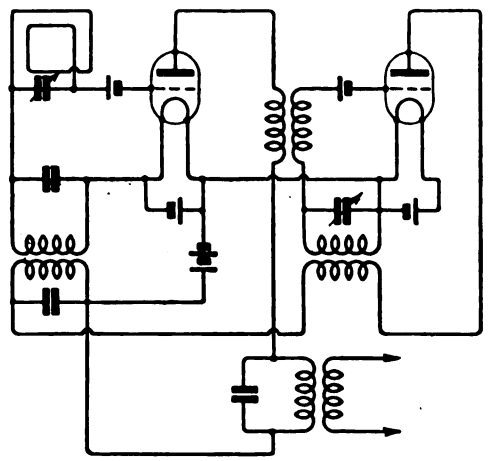

Fig. 3. The first valve amplifies the incoming signal and the intermediate frequency signal and the second valve is the second harmonic oscillator.

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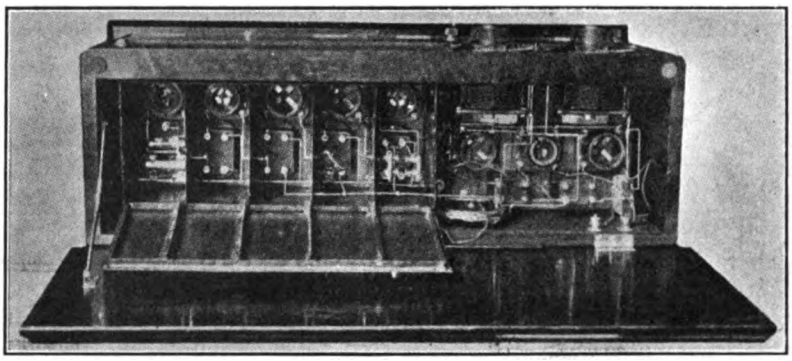
variety of harmonics. The second harmonic combines to produce beats with the incoming signals of the desired intermediate frequency. The valve rectifies them to produce the desired intermediate frequency, and through circuits C and D the new frequency is supplied to the amplifier.



Rear view of an early type of super-heterodyne receiver.

As circuits A and B are tuned to frequencies differing by approximately 100 per cent., a change in the tuning of one has no appreciable effect on the tuning of the other. This arrangement solved the oscillator problem, and in addition practically eliminated radiation.

The next step in the reduction of the number of valves was to make the radio-frequency amplifier perform the function of amplifying the intermediate frequency as well. The general arrangement of the circuit employed is shown in Fig. 3.

The signals received by the loop aerial are amplified at radio frequency by the first valve and applied to the grid of a second harmonic oscillator by means of an untuned radio-frequency transformer. The combined signalling and heterodyning currents are then rectified by the second valve, producing a current of the intermediate frequency, which is applied to the grid of the first valve, amplified therein, and passed to the second stage of the intermediate amplifier.

A more practical arrangement for the circuit is shown in Fig. 4, where the secondary winding of the first intermediate frequency transformer is connected to the grid of the first valve in parallel with the frame aerial. The parallel type of circuit eliminates a variety of reactions which would give rise to oscillations of various frequencies, and in addition prevents the reception of long wave signals by the intermediate frequency amplifier.

The arrangements just described were incorporated in a receiver which measured 18 ins. × 10 ins. × 10 ins., and was completely self-contained, the batteries, frame aerial and loud-speaker mechanism being enclosed in the box.

The possibilities of this type of receiver were recognised by the Westinghouse Electric and Manufacturing Company, the General Electric Company, and the Radio Corporation of America, who placed the invention in a commercial form. Many improvements and some new ideas of

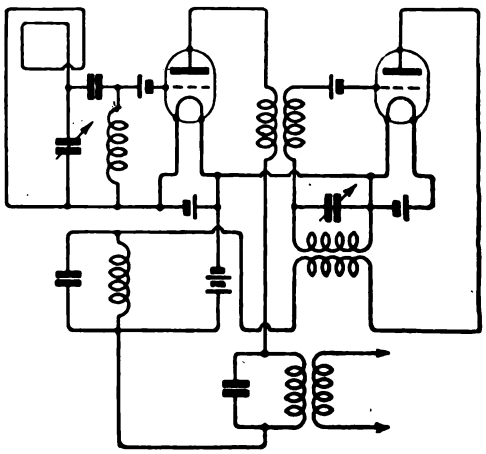


Fig. 4. A more practical circuit than that of Fig. 3.

designs have been introduced. In the final instrument an additional stage of low frequency amplification was added in order to ensure operation within steel buildings.

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TWO REFLEX REINARTZ CIRCUITS.

Two circuits are described, one having a crystal detector and the other a valve detector.

By H. C. EXELL, B.Sc.

IN *The Wireless World and Radio Review* for May 13th, 1922, a full description of a simple Reinartz circuit was given, and in the issue for the following July 8th the addition of one stage of H.F. amplification was described.

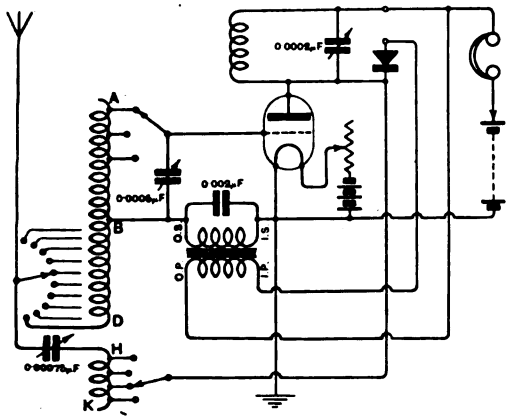

Fig. 1. A reflex Reinartz receiver employing a crystal detector.

It occurred to the author that L.F. amplification could be obtained by using a reflex or dual circuit, thus extending the use of this most selective method of tuning.

Two circuits were tried out, the first (Fig. 1) using crystal rectification and the second (Fig. 2) using a valve detector, both operating successfully. The latter circuit, using two valves, gave trouble at first owing to oscillations being set up which were just within audible frequency, and seemed very similar to the Armstrong oscillations in the super-regenerative circuit. These were apparently due to the winding of the L.F. transformer in the grid circuit of the first valve shunted by a condenser, and that in the plate circuit of the second valve, and were eliminated by careful design of the choke (C), Fig. 2.

TUNER.

The aerial coil (BD) is a continuation of the grid coil (AB). For tuning up to about 500 metres 50 turns of No. 20 D.C.C. wire are wound on a 3 in. diameter former, tappings being provided for by baring a short length of wire and twisting into a loop, to which the lead to the contact stud is subsequently soldered. Tapping points are arranged for after 10, 20 and 50 turns have been wound on, the final point being B (Fig. 1), and this is taken to a terminal on the panel on which the completed coil is mounted. The winding is continued past B for 10 more turns, tappings being taken from each turn. The reaction coil is then wound on the same former, starting immediately after the finish of the aerial coil. If the one-valve and crystal circuit is used (Fig. 1) the reaction coil is wound in the same direction as the aerial coil, but if the two valves are to be employed (Fig. 2) its direction is reversed, or else the connections of the reaction coil are made in the opposite way to that shown in the diagram.

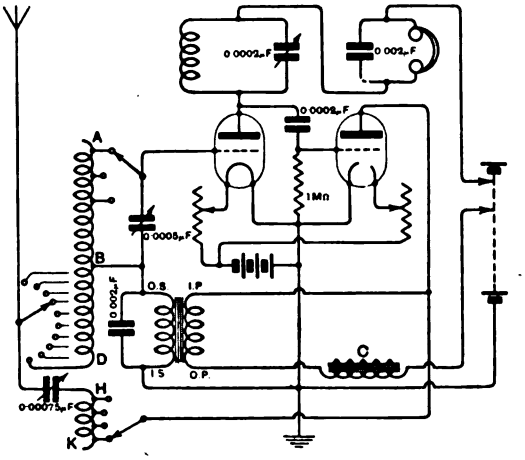

Fig. 2. In this reflex Reinartz receiver a valve detector is used.

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Thirty turns of No. 20 D.C.C. wire are sufficient, and the coil is tapped at 10, 20 and 30 turns. A former for the whole tuner and reaction coil about 5½ ins. long, will be necessary, and when wound may be mounted behind an ebonite panel 6 ins. by 6 ins., fitted with three switches and contact studs. One ten-point switch for the aerial coil, a three-point switch for the grid coil, and a four-point switch for the reaction coil.

ANODE COIL.

A decided advantage is gained by winding this with thick wire and employing a small tuning condenser. The maximum capacity should not exceed 0·0002 microfarads, and for tuning over the broadcast range the following coil will serve. Ninety turns of No. 20 D.C.C. wire are wound on a 3 ins. diameter former, and tappings are taken at 45, 60, 75 and 90 turns. The coil may be mounted on a panel with two terminals and a four-point selector switch to accommodate the tappings.

CONDENSERS.

As given in the diagrams, a 0·00075μF condenser is used for reaction, a 0·0005 μF to tune the grid circuit, and a 0·0002μF for the anode circuit.

It would undoubtedly be better to use a smaller condenser across the grid circuit, and a correspondingly larger grid coil, but this would, of course, alter the reaction effects, and in all probability it would in that case be found better to alter also the size of the reaction coil and condenser. The former values were, however, used in the author's circuit and proved satisfactory, so were unaltered.

In the crystal detector circuit (Fig. 1) no condenser should be used across the primary of the L.F. transformer or the 'phones, as the H.T. is supplied in shunt. If condensers are used the impedance will be insufficient to choke back the H.F. oscillations, and it will be difficult to make the circuit oscillate.

In the two-valve circuit, however, the telephones are in a circuit where H.F. oscillations may be bye-passed by a 0·002μF condenser across them. In the latter circuit the 0·002μF condenser across the secondary of the L.F. transformer, *i.e.*, in the grid circuit of the first valve, may be reduced in size with advantage in many cases, and possibly a condenser as low as 0·0003μF may be found satisfactory.

CHOKE C.

This component is of high importance in this particular circuit on account of oscillations just within audible frequency which are liable to be set up. A telephone earpiece and a L.F. transformer secondary were tried and found to be not very successful.

A suitable choke may be made by winding 3 ozs. of No. 40 gauge wire on a core of iron wires ⅜ in. in diameter and about 6 ins. long, the winding occupying 2 ins. in the centre. When the winding is completed the ends are brought to terminals, and the iron core wires bent back round the winding as in a hedgehog transformer.

Hard valves are used with normal H.T. A perikon crystal detector will be found satisfactory, as it is sensitive and has the advantage of stability. Zincite-bornite is a good combination.

It will be found when using this circuit, that interference from local broadcasting can be eliminated, and the freedom from other extraneous noises, such as atmospherics, is remarkable.

ST. DUNSTAN'S NINTH ANNUAL REPORT.

The two outstanding impressions left by a perusal of the Ninth Annual Report of St. Dunstan's, are, firstly, the splendidly permanent effects of the work undertaken by the Organisation on behalf of the Empire's war-blinded men, and secondly, the efficiency and business-like character of the administration.

There is very clear evidence on reading this detailed Report of past achievement, present endeavour and future responsibilities, that St. Dunstan's work is far from finished yet. It will probably come as a shock to many of us who were inclined to regard the work of St. Dunstan's as necessary only during the years of war, to learn that since the Armistice over six hundred men have been admitted to St. Dunstan's care and training.

The Council are to be congratulated upon showing a small balance on the right side. But it is pointed out that this position has only been rendered possible by the exercise of the most rigid economy and unremitting effort, no less than nine-tenths of the yearly income needed having to be raised by appeals to the public.

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The Third Annual Chicago Radio Show, representing one hundred and eighty leading American manufacturers, besides English, French, Italian, German and Japanese, opened on November 18th.

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Transmission of pictures by telegraph and wireless has been introduced as a branch of study at the Berlin Technical High School.

* * * *

The Marconi Company announces a reduced tariff for wireless messages to Australia on and after December 1st.

* * * *

The British Broadcasting Company celebrated its second birthday on Friday, November 14th.

* * * *

BROADCASTING FROM BELGRADE.

The English Sports House at Belgrade advises us that the local broadcasting station transmits concerts every Tuesday, Thursday and Saturday from 5.45 to 6.45 p.m. (G.M.T.) on a wavelength of 1,650 metres.

SPANISH BROADCASTING PROGRESS.

The new Barcelona broadcasting station has been allotted the call sign **EAJL** and is at present testing on 325 metres with a power of 100 watts. The times of these transmissions are 6 to 7 p.m. and 9 to 11 p.m. Regular programmes will shortly commence with the broadcasting of operas from the Liceo Theatre in Barcelona.

NEW FRENCH BROADCASTING STATION.

French listeners remote from Paris have recently been bewailing the fact that, beyond the indifferent reception from the Parisian stations, they are unprovided for in the matter of broadcasting.

Those in the south-west parts of France will soon have their troubles removed, for a new broadcasting station is to be established at Agen, in the Department of Lot-et-Garonne, to operate on a wavelength of 300 metres. Official permission to erect the station is expected very shortly. The suggested power of 200 watts is somewhat low, but it is probable that this will be increased if public demand is forthcoming.

AUSTRALIAN SHORT WAVE SIGNALS HEARD.

What appears to be the first report of the reception of short wave amateur transmissions from Australia has been sent to us by Mr. W. J. Randell **(G 6UD)** of 104 Talbot Street, Nottingham. At 7.45 a.m. on November 9th, states our correspondent, a faint C.W. station was heard calling **CQ** de **A 8GZ** on a wavelength between 75 and 80 metres. The station was heard a few minutes later, but was jammed by **U 1CMP.**

A further interesting report has reached us from Mr. F. Walker, of Walton-on-Thames, who at 6.35 on the evening of November 12th, heard the Australian short wave station **A 2ME.** Although the complete message was not heard, it was signed "Fisk," and addressed to **ICCN.** The signals reached a maximum intensity of about R6 at 7 p.m., on a receiver consisting of a detector and one note magnifier. It is, however, probable that **A 2ME** was using much greater power than is customarily used by amateur transmitters. Of considerable importance is the fact that good reception was obtained at 7 in the evening, exactly a twelve hours' difference from the time when amateur communication with New Zealand has been most successful. From this it would appear that darkness over half the globe between the communicating stations is essential, though whether it be east or west does not matter.

The first Cheshire amateur to effect two-way communication with New Zealand is Mr. H. Williams **(2 JF)** of Wallasey, who successfully worked for a period of twenty minutes with **Z 4AG** on the morning of November 10th.

New Zealand **4 AA** was heard by Mr. E. Shackleton of Leeds at 6.58 a.m. (G.M.T.), on November 9th, working on 93 metres.

WIRELESS FOR LEPER COLONY.

The leper colony on the Island of Culion, in the Philippines is shortly to be linked to the outer world by wireless. A receiving set, presented by an electrical company, is being installed.

PROFESSOR BRANLY DECLINES BIRTHDAY CELEBRATIONS.

Those familiar with the temperament of Professor Edouard Branly were not surprised by the news that he had declined the proposal for the celebration of his 80th birthday with a banquet. The famous French radio pioneer intimated that he never dines out.

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Mr. Godfrey C. Isaacs, who has resigned the Managing-Directorship of the Marconi Companies.

AN IMPORTANT RESIGNATION.

It was officially announced on November 13th that Mr. Godfrey Isaacs, for reasons of ill health, had been compelled to relinquish the Managing Directorship of Marconi's Wireless Telegraph Co., Ltd., and the Marconi International Marine Communication Co., Ltd., a position which he had held with distinction for fifteen years. The Companies will continue to have the benefit of his services in a consultative capacity. We feel sure that our readers will endorse our hope that Mr. Isaacs' recovery will be rapid and complete.

Mr. Isaacs is succeeded by the Rt. Hon. F. G. Kellaway, who joined the board of the Marconi Company in November, 1922. Mr. Kellaway will be remembered as the Postmaster-General who was responsible in 1922, for the institution of broadcasting, and for the drawing up of the agreement between the Post Office and the British Broadcasting Company.

EIFFEL TOWER SHORT WAVE TESTS.

Although the series of short wave tests from the Eiffel Tower have been temporarily suspended, the meteorological transmissions on 115 metres are being maintained at the following times (G.M.T.):

2.20 p.m.	Le Verrier bulletin.
11.0 p.m.	Maury bulletin.
4.0 a.m.	Repetition of Le Verrier and Maury bulletins.

ZURICH ASKS FOR REPORTS.

A Swiss broadcasting station which is worth an attempt to hear is Zurich. It has already been picked up in London with detector and L.F. This station transmits nightly from 8.15 onwards on 650 metres, and employs a power of 500 watts. The announcements are made in German, and reports, which are welcomed, should be addressed to Radiogenossenschaft, Zurich, Switzerland.

M. LEON DELOY'S SUCCESS.

M. Léon Deloy, of Nice, reports that he has now successfully worked with a New Zealand amateur. On October 30th, at 6 a.m. after communicating with Mr. Carlos Braggio (**DA8** ex **CB8**), M. Deloy made his first attempt to call New Zealand. He was immediately answered by two New Zealand stations, but owing to bad receiving conditions in France he did not hear their replies, which were passed on to him later by M. Menars (**F8FJ**), of Le Blancat.

On the following morning, however, successful two-way communication was established with **Z4AK**, who reported M. Deloy's signals as strong. The New Zealander's transmission was also good but signals faded, until at 7.4 a.m. they were indistinguishable.

M. Deloy points out that Nice is further away from New Zealand than the whole of Great Britain and the rest of France, the distance being actually

The Rt. Hon. F. A. Kellaway, who succeeds Mr. Isaacs, has had a wide experience in Government departments.

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A novelty of the Lord Mayor's Show this year was the broadcasting of a description of the procession by onlookers. John Henry was one, and he is seen on the left in our photo, in a room overlooking Northumberland Avenue, down which the Lord Mayor passed.

11,220 nautical miles. M. Deloy's success is not surprising, for it will be remembered that he was the first European amateur to get in touch with America.

LONGITUDE BY WIRELESS.

A scheme to ascertain by wireless whether the world's longitudes are trustworthy, is being undertaken by General Gustav Ferrié, Chief of Radio Communications of the French Army.

Interviewed by our Paris correspondent, General Ferrié said that leading scientists have long suspected a certain error in the longitudes of the world, especially since the discovery of latitude variations caused by the erratic motion of the Poles. The great difficulty in checking longitudes has always been the small unavoidable variation in ship's chronometers. This trouble it is hoped to overcome by a chain of wireless stations. The original intention had been to operate with three stations, one on the American Pacific coast, one in China and one on the Mediterranean, but this number was found insufficient and plans are therefore delayed until an adequate number is available. This interesting research will probably commence in the winter of 1925.

RADIO AND RUM SMUGGLERS.

Wireless warfare is taking place in American waters owing to the action of the United States Coastguard Service in equipping 475 vessels with radio apparatus to combat the "bootleg" rum fleet.

Many of these illicit craft are fitted with efficient wireless installations, by means of which they are able to communicate with smugglers on the coast. The aim of the U.S. authorities is to intercept these messages, with results that should make America drier still.

THE AERMONIC VALVE HOLDER.

We regret that in our description of the Aermonic Valve Holder on page 138 of our issue of October 29th, the name of the manufacturer was inadvertently omitted. This useful component is a product of Messrs. V. R. Pleasance, of 60 Fargate, Sheffield.

CKAC, MONTREAL.

An interesting photograph appeared in our last issue showing the organ in the studio of **CKAC**, the famous broadcasting station of "La Presse," at Montreal. This photograph was kindly supplied through the courtesy of the Internacional Ido-Radio-Klubo, to whom acknowledgment should have been made. This society is the international organisation of Ido-speaking amateurs.

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Radio Society of Great Britain

An ordinary general meeting of the Society will be held at 6 p.m. (tea at 5.30), at the Institution of Electrical Engineers, Savoy Place, W.C.2, on Wednesday, November 26th, when Mr. L. B. Turner, M.A., will deliver a lecture entitled: "Wavemeters."

T. AND R. NOTES.

The transmissions of the Canadian amateurs are now rapidly growing in number, a welcome fact, for except **C 1AR**, little activity has been apparent from them.

Our old friend **2 BG** of Montreal, asked me to inform British transmitters that the Canadian second district are very anxious to test with us, and will work on 70-80 metres. I replied that we were all anxious to work the Canadian 4th and 5th districts, and gave him our wavelengths and times.

The American 4th district stations now come in very well on 70-80 metres, and a newcomer, **4 QF**, puts out a very good signal. Doubtless our members are ambitious to work the New Zealanders, but they would be well advised not to lose sight of the fact that the period of audibility of their signals is getting later every day, owing to their fast approaching summer and longer days.

We have yet to work the 5th, 6th and 7th districts in America, for although one of our members claims to have worked a 6th district station, we must await confirmation of this.

A member also reports having worked **U1 CMP** on about one watt with an ordinary R valve. This seems indeed a record, and let us hope that confirmation follows! A report has also been received that **2 SH** was received in Johannesburg in September. Also a cable has come to hand stating that Finnish **2 NM** was received in Urdarband, India, on the 7th of November, at 2330 G.M.T. I have accordingly cabled that our members will transmit every Wednesday at 2330 G.M.T. Please note this. Wavelengths should be between 90 and 120 metres. **5 MO** reports reception of Australian **2 AJ, 2 AL,** and **N.Z. 4 AA** between 7 and 7.30 p.m., and members are requested to keep watch at these hours.

In conclusion, members who wish to carry out special tests should send me particulars, when I shall be happy to arrange for co-operative tests with other members.

G. MARCUSE.
(Hon. Secretary, T. and R. Section,
Radio Society of Great Britain).
November, 11th 1924.

* * * *

A series of elementary lectures on "Magnetism and Electricity" is being given before the Tottenham Wireless Society by Mr. Usher. In the first lecture, given on October 29th, the properties of natural and artificial magnets were dealt with, together with magnetic fields, induced and electro-magnetism. Many interesting experiments were performed, illustrating the various points raised.

* * * *

Members of the Borough of Tynemouth Y.M.C.A. Radio and Scientific Society recently enjoyed an excellent paper on "A Universal Three-Valve Receiver," by Mr. G. J. S. Littlefield, L.D.S.

A minute description of the instrument was given, and the lecturer interestingly explained the theory of the set, from the moment the oscillations are received on the aerial until the audible signals were heard in the telephones.

* * * *

Wavelength, and mathematical data for calculating the length of wire necessary for correct tuning were the subjects of study at a recent meeting of the Brockley and District Radio Association, when this branch of research was interestingly dealt with in a paper by the President, Mr. B. Hughes, M.I.B.

After some instructive demonstrations of aerial oscillations, the lecturer explained the formula for calculating the inductance and capacity required for a given wavelength.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 19th.

Edinburgh and District Radio Society. At 8 p.m. At 117 George Street. Fifth General Meeting of Series.

Tottenham Wireless Society. Practical Demonstration of Valves.

Bristol and District Radio Society. Wireless Lecture No. 4. By Mr. W. A. Andrews, B.Sc.

Radio Research Society, Peckham. At 44 Talfourd Road. Lectures: "Gas and Petrol Engines," "Carrier Current Telephony," "Wired Wireless."

THURSDAY, NOVEMBER 20th.

Bournemouth and District Radio and Electrical Society. At 7 p.m. At Canford Hall, St. Peter's Road. Lecture: "Valve Manufacture" (Illustrated). By Mr. F. E. Goldup, of Mullard Radio Valve Co.

Luton Wireless Society. At 8 p.m. At Hitchin Road Boys' School. Demonstration of High Tensionless Circuits. By Mr. W. J. Banks, of the Bute Electrical Co.

West London Wireless and Experimental Association. At the Belmont Road School, Chiswick, W.4. Lecture: "Insulation Testing." By Mr. L. Shepherd.

FRIDAY, NOVEMBER 21st.

Bristol and District Radio Society. At Comers Restaurant, High Street. Social Evening from 7 p.m. onwards.

Sidcup and District Radio Association. At 8 p.m. At Sidcup Grammar School. Opening Meeting. Demonstration of Coil Winding.

TUESDAY, NOVEMBER 25th.

Leicestershire Radio and Scientific Society. At the Y.M.C.A. Lecture: "Simple Radio Measurements." By Mr. Cyril T. Atkinson, A.I.R.E.

Radio Society of Highgate. At 8 p.m. At the Literary and Scientific Institute. Lecture: "Coils for Short-wave Reception." By Mr. J. H. Reeves, M.A.

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AMERICAN BROADCASTING STATIONS IN THE TESTS.

With the object of helping readers to identify the American stations participating in the Transatlantic broadcasting tests during the last week of November, we append a list of the more powerful stations in America. Besides these a number of the lesser stations will also take part.

KDKA	Westinghouse Electric and Manufacturing Co., E. Pittsburg, Pa., 326 metres.
KFKX	Westinghouse Electric and Manufacturing Co., Hastings, Nebraska, 285 metres.
KGO	General Electric Co., Oakland, California, 312 metres.
KUVQ	Kreetan Co., Johnswood, Drummond I. Mich., 450 metres.
KYW	Westinghouse Station, Chicago, Ill., 536 metres.
WBAP	Star Telegram, Fort Worth, Texas, 476 metres.
WBZ	Westinghouse Electric and Manufacturing Co., Springfield, Mass., 337 metres.
WEBH	Edgewater Beach Hotel, Chicago, Ill., 370 metres.
WGN	*Chicago Tribune*, Chicago, Ill., 370 metres.
WGY	General Electric Co., Schenectady, N.Y., 380 metres.
WNYC	Dept. of Plant and Structures, New York., 526 metres.
WSAI	U.S. Playing Card Co., Cincinnati, Ohio, 309 metres.
WTAM	Willard Storage Battery Co., Cleveland, Ohio, 390 metres.

The powerful Canadian station, **CKAC**, owned by "La Presse," Montreal, will also participate, operating on 425 metres.

FOUR BROADCASTING BOOKS.*

The romance of the origin of broadcasting in Britain forms the preliminary theme of Mr. Reith's stimulating book. In the opinion of the author, broadcasting is only in its infancy, both as to its age and its possible influence on civilisation. Perhaps the most absorbing part of the book is that in which are discussed the educational, political, literary and religious possibilities of the new art. Will it have to develop its own news agency? This admirable volume supplies the reader with information and suggestions, and asks for his help, so that broadcasting may make the maximum and best contribution to life.

In the pages of "From My Window," many listeners will recognise the pleasantly intimate talks broadcast weekly from **2 LO** by that intriguing personality "Philemon." Sane and helpful, without being sanctimonious, these talks cover a wide vista of human experience, revealing a breadth of vision not often encountered in the world to-day.

The uncles and aunts of the B.B.C. are to be congratulated on the appearance of their two new annuals, for boys and girls respectively, published by Mr. Cecil Palmer. The miracle of these books is their price, for it is difficult to understand how, for the modest sum of three shillings, it has been possible to produce such an artistic conglomeration of everything likely to delight a child. They can be warmly recommended as Christmas gifts.

*"Broadcast over Britain." By J. C. W. Reith, Managing Director of the B.B.C. (London: Hodder & Stoughton, Ltd., 231 pages. Price 6s. net.)

"From My Window." By "Philemon." With a foreword by J. C. W. Reith. (London: Hodder & Stoughton, Ltd., 255 pages. Price 3s. 6d. net)

"Hullo Boys," and "Hullo Girls." Two new Children's Annuals (London: Cecil Palmer, 49 Chandos Street, W.C.2. Published by courtesy of the B.B.C. Price 3s. net each.)

Glasgow (September 20th to October 6th).
French: **8 BN, 8 CA, 8 DI, 8 ÉM, 8 ÉU, 8 GI, 8 NS, 8 OM, 8 PP, 8 PQ, 8 RR, 8 SG, 8 SR, 8 WL, 8 XR, 8 ZM, 8 ZZ, 8 JHL, 8 LMT.** Finnish: **FN 2 NC.** Swedish: **SMZP, SMZV.** Dutch: **LOOA, OBU, OQW, OXP.** Danish: **7 BG, 7 EC, 7 ZM.** Various: **3 CA, 3 XO, YA 4 O, 4 XZ, 4 RS, 1 CN, W 2, 4 ALS, IAR, IXW, IHT.** (A. Ballantyne).

Copenhagen (May to October 15th).
British: **2 JF, 2 JU, 2 NM, 2 SR, 2 XG, 2 XY, 2 ZU, 5 BT, 5 FS, 5 LF, 5 LS, 5 MA, 5 NW, 5 OK, 5 RO, 5 SZ, 6 GM, 6 MP, 6 UD, 6 XG, 6 XX.** French: **8 BN, 8 BRG, 8 DA, 8 DI, 8 ÉN, 8 ÉU, 8 PA, 8 RS, 8 WL, 8 WZ, 8 ZM, 8 ZN, 8 ZZ.** Danish: **7 EC, 7 MZ, 7 QF, 7 ZM.** German: **4 BK, 4 C 2, 4 QS, 4 RS, 4 YZ.** Finnish: **FN 1 NA, FN 3 NB, FN 2 NM.** Swedish: **SMZN, SMZQ, SMZV, SMZY, SMZZ.** Dutch: **OBA, OBQ, OGA, OMS, OMN, ORW, OSS, OXA, OXP.** Italian: **1 FP, 1 GT, 1 NA.** Various: **3 NB, UFT 2, P I, 3 ZP.** (Borge Jorgensen.)

Sheffield (October 11th and 16th, on 80 to 150 metres.).
French: **8 BRG, 8 CA, 8 CM, 8 DD, 8 DP, 8 GF, 8 GI, 8 GL, 8 JBL, 8 PA, 8 VV, 8 XH.** Dutch: **OBA, OII, OKN, OMS, ORE.** Swedish: **SMZN, SMZV.** Finnish: **FN 2 NM, FN 3 NB.** German: **4 QS, 4 RS.** Danish: **7 EC.** Various: **3 DAX, B 7.** (Leonard H. Crowther, **2 LH**).

Weybridge (September 21st).
French: **8 DT, 8 RB.** Dutch: **OGC, OMJ.** Danish: **7 ZM.** Unknown: **IMO.** (o—v—o.) (J. F. Perrin, **5 ZN**).

Broadstone, Dorset (August 28th to September 14th).
French: **8 BG, 8 BN, 8 BS, 8 DP, 8 DS, 8 ÉP, 8 FC, 8 FH, 8 FW, 8 MN, 8 PP, 8 QN, 8 SR, 8 UU, 8 WZ.** Dutch: **OMS.** Various: **IMT, 3 AD, 3 XO, 24 XY, MM.** (1—v—1.) (J. F. Metcalfe, **2 AHX**).

Watford, Herts (during October. All below 150 metres).
French: **8 AL, 8 BRG, 8 BT, 8 BU, 8 CM, 8 CN, 8 CO, 8 DO, 8 ÉK, 8 ÉM, 8 ÉN, 8 GH, 8 GM, 8 JBL, 8 QG, 8 WK, 8 WZ, 8 ZM, 8 ZU, 8 ZZ.** American: **1 AUR, 1 BE, 1 BGC, 1 BQ, 1 BRB, 1 ER, 1 JW, 1 KC, 1 LD, 1 SE, 1 SW, 1 XW, 1 XAV, 2 AAY, 2 BGG, 2 BRB, 3 BDO, 3 BGC, 3 BQU, 3 BTU, 3 CBI, 3 CDG, 3 HH, 3 JW, 3 VW, 8 CYL, 8 NB, 8 XS.** Miscellaneous: **SMZP, YA 74, YA, PZ, OSK, 4 QS, 4 UU, EAR 3, NAB 2, 9 AD.** (H. E. Nicholson, **6 VP.**)

Cambridge (October 11th to November 1st).
French: **8 AL, 8 BC, 8 ÉV, 8 ÉX, 8 FI, 8 FM, 8 FQ, 8 FS, 8 GH, 8 GL, 8 GM, 8 GN, 8 HSM, 8 JBL, 8 QG, 8 TO, 8 WAL, 8 ZUT.** Dutch: **0 GA, 0 XX, 0 ZA.** Swedish: **SMZQ, SMZN.** Danish: **7 ZM.** Finnish: **1 NA.** Belgian: **4 ALS.** American: **1 CAK, 1 CC, 1 CKP, 1 BGQ, 1 EN, 1 KC, 1 OW, 2 AGW, 2 ANM, 2 MC, 4 SA, 8 BAW, 8 XS.** Canadian: **1 DM, 1 DQ.** Unknown: **AGA, AIN, B 7, GBGM, YA 77, 3 AF, 3 DAX.** New Zealand: **2 AC, 4 AA, 4 AG.** (o—v—1.) (G. W. Thomas, **2 AQK.**)

ANOTHER AUSTRALIAN HEARD.

As we go to press a report reaches us that Mr. F. Walker, of Walton-on-Thames, has heard the Australian amateur **3 BQ** transmitting on 93 metres. **3 BQ** was picked up at 6.50 a.m. on Friday, November 14th and continued to transmit until 7.5 a.m.

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UNSOLVED PROBLEMS OF WIRELESS.

By R. H. BARFIELD, M.Sc.

(*Continued from page 218 of previous issue*).

DISCUSSION.

THE PRESIDENT, opening the discussion, said: I have to leave in a few minutes, and if you do not mind I will break the rule and open the discussion, and then ask Mr. Coursey to take the chair. The lecturer has laid a great deal on the shoulders of the upper atmosphere. It seems to have to bear the blame or the credit for everything that happens. It is credited with helping us to get round the globe, and it is debited with producing night variations in direction finding. The upper atmosphere is, as a fact, a very useful thing to us; as useful as the lower atmosphere. For instance, it is the upper atmosphere which prevents the meteors reaching earth. If it were not for the upper atmosphere we should have a great many more meteors landing on the earth's surface, or on human beings or houses, than we do, and the earth would be a dangerous place to live on. In the same way, the upper atmosphere keeps us from hearing, in wireless receivers, the atmospherics, as we call them, that would come from the sun and which would get through the upper atmosphere if it were not conducting. I think anyone with a little imagination can realise what might happen when they see pictures of these enormous prominences which are shot out of the sun. Prominences are being shot out daily, and the gases of which they are composed are highly incandescent and ionised, and they leave with enormous speeds far greater than matter is ever made to move on this earth. The friction and the ionisation must be enormous, and I think you will agree with me that the electrical discharges must be on the same enormous scale. Consequently, electric waves must be coming from the sun in the way of disturbances to wireless telegraphy, and probably would reach us in great force if the upper layers of the atmosphere were not conducting enough to prevent them penetrating them. I am only adding to the burdens of the upper atmosphere by suggesting these things. The other things which the author has suggested I imagine most of us agree with broadly. He spoke first of signals getting round the globe. Of course that would be impossible by aid of mere diffraction of the rays. You have to invoke the upper atmosphere, the ionised layer in the upper atmosphere, to enable us to understand that phenomenon at all. Then, to understand the next phenomenon, the difference between day and night, you have to invoke still another phenomenon, and I myself, in various publications, have suggested that the layers below the ionised layer—below the Heaviside layer, which, we assume, is permanently ionised—are ionised by the sun daily and de-ionised every night. Hence the waves, especially the short waves, find difficulty in travelling in the day. When these layers become de-ionised at night, the Heaviside layer is exposed to the earth and the short waves especially can run about, so to speak, underneath the ceiling quite freely. The third problem was directional finding errors at night. Some people have suggested that the Heaviside layer is rather corrugated, or bent. I have forgotten who it was once suggested in this room that it was rather like playing billiards on a bumpy billiard table, the billiard table being upside down—the Heaviside layer—and the balls being the rays. That, however, is nothing like a sufficient explanation, and much more than that is wanted because, as a fact, the rays that are received seem to be polarised in different planes from the vertical plane in which the ordinary daylight signals are polarised, so that we want something that will twist or turn the plane of polarisation as well as reflect or refract, and that explanation has not been forthcoming yet, although, again, suggestions have been made that perhaps the motion of ions under the influence of the waves in the earth's magnetic field may cause some of the trouble. The question of fading, again, the author blames the upper atmosphere for, probably quite justly. It does seem that masses of atmosphere may become electrified or ionised. When you get a portion of atmosphere without any of these banks of ionised air—a portion thousands of miles long, of course—then you get good signals, and when you get ionisation taking place in the space between two stations you get fading. I leave you to discuss this, and I will now ask Mr. Coursey to take the chair.

Mr. G. G. Blake.

One theory has occurred to me which has not been mentioned. It is a very old one, and I do not put it forward in any way as a complete solution. In 1899, when Nikola Tesla introduced what he called "world-wave" telegraphy, he claimed to make the world an oscillator. In effect, the idea is this: that in true Hertzian wireless we have two oscillators insulated from the earth, while in the wireless we now use we have in nearly every instance an earth connection and one aerial or oscillator. The idea then would be that the aerial acts as a large condenser and is charged up and discharged to earth suddenly, and causes, shall we say, wired wireless on the earth, independent altogether of the Hertzian radiation that takes place, and possibly to a greater extent. I do not know whether there is any use for this old theory now. It would not, of course, account for fading in any way, or for the lightness and darkness effect and many of the things that require explaining. I believe that Tesla was led to this idea one day by

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observing a passing thunderstorm.* He was in his wireless cabin listening-in when it came over, and he heard the storm getting nearer and nearer, then it passed away into the distance. He noted that as he listened the atmospherics at one moment sounded loudly, a period of time followed during which they faded almost entirely away, after which they again grew to a maximum. This process was repeated several times, and he concluded that the whole earth was oscillating electrically. As the storm travelled along the station alternately entered nodes and loops of the waves.

Captain M. A. Ainslie.

A point has occurred to me in connection with the phenomenon of fading. It does not seem to me necessary to postulate any serious irregularities in the Heaviside layer, certainly nothing that could be compared with "bumps" on the cushions of a billiard table. My idea is that possibly fading is mainly an interference effect. The waves from a transmitting station would normally, assuming the Heaviside layer to be spherical, follow the shortest possible path, like light. They will also follow other paths if there are any extensive deviations from the sphere in the lower surface of the Heaviside layer. I think, therefore, that it would be possible, without postulating any fundamental deformation of the Heaviside layer, that a slight deformation might set up, temporarily, a number of other possible paths for the waves, in which case there might very easily, and probably would, be well-marked phase differences between the waves arriving by the various paths. This might easily cause interference at the receiving station, which might, according to phase, increase or diminish the intensity of the resultant wave. This effect might go through all its variations in a short time, and it seems to me that fading might conceivably be set down to something of this description.

Mr. E. H. Robinson.

There is one interesting theory which I think it would be a pity to ignore, and I think it is quite a new one. A week or two ago Professor Howe, in *The Electrician*, suggested a theory with regard to transmission which is extremely ingenious and at the same time very simple. Suppose you have a station at a certain point on the earth, and that station is sending out in all directions. The waves spread out in zones very much like waves produced in water when you drop a stone in it, but the difference between the water analogy and Professor Howe's theory is this, that, if you drop a stone into a flat sheet of water, the waves go out and out and the intensity dies off continuously. Assuming, as has been pointed out to-night, that waves travelling round the earth are confined to a spherical shell between the surface of the earth and the effective level of the Heaviside layer, they will take the form of zones spreading out from the source and following the surface of the earth with decreasing intensity as they expand. The maximum size will be at the equator, where the intensity will be a minimum. After they have passed the equator they will contract naturally, until at the Antipodes they will concentrate to a point again. It is perfectly reasonable to suppose that the intensity there will be a second maximum. Professor Howe pointed this out some weeks ago, and said that on this theory you would expect the maximum intensity of the signals again at a point diametrically opposite on the other side of the earth to the transmitting station. I thought it would be interesting to bring that out in view of the fact that communication has been established with the Antipodes during the last few days. I am told by amateurs who have been connected with the work that at such times as they have been in communication with New Zealand, reception conditions for American signals have not necessarily been good. In fact, Mr. Hogg tells me that he has heard these New Zealand stations when the American stations could not be heard, and it is a significant fact that two-way communication has been maintained with New Zealand at a time when I do not believe that two-way communication has been established with the Argentine, though I believe the attempt has been going on for a long while.

Mr. M. Child.

As a matter of historical interest, I would like to point out that the theory that one would expect to find the maximum strength of signals at the Antipodes of a station—I am referring to long distance stations—was put before me by Mr. Glew, who is a very well known radiologist and scientific worker, I think in the year 1901. It was just prior to the time when Mr. Marconi was expecting to get his stations finished to test across the Atlantic. Mr. Glew told me that he thought that if we looked for the signals at the Antipodes of the transmitting station, we should be more likely to get them there than by just going across the Atlantic. Thus you see that these theories which are sometimes given to us by many people are not new in any way. Of course, I do not wish to cast any aspersion upon what Professor Howe has proposed; perhaps it was absolutely original. A matter that has not been brought out this evening is the fact that these long distances have been covered with such small powers, and the distances so covered seem to be increasing as the wavelength goes down. It is this short wave question that we have not heard very much about to-night. I have heard of people receiving exceptionally strong signals with wavelengths as low as 40 or 50 metres, and it would therefore appear that there is some definite ratio of increased signalling strength at night with a given distance, as the wavelength goes down, the primary power being approximately the same. I suppose that when we have carried on this long distance communication for a sufficient length of time so as to enable us to collate some of these facts, we shall be able to determine a good deal more about the conditions necessary for satisfactory communication on exceedingly short wavelengths. Apart from that, we may be able to reproduce some artificial load. We may be able to introduce some artificial conditions under which we can test with waves of a few centimetres, and reproduce, as it were, if possible, our local conditions by means of laboratory tests on a scale which hitherto we have not been able to. Perhaps that is looking a little too far ahead, but it seems to me that when once we can make laboratory tests with extremely short wavelengths, which we can get much more

* He observed the thunderstorm in 1899 and patented his method of "world-wave" telegraphy in 1905.

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under control, then we may be able to determine with a much greater degree of exactitude the actual conditions under which wireless waves are radiated and received over the whole surface of the globe.

Mr. F. L. Hogg.

It seems to me that recent work on short wave wireless telegraphy gives great support to the Heaviside layer theory, and also to the theory of Professor Howe. In that connection, however, it is interesting to note that we cannot communicate with California, for instance, and yet these signals reach the Antipodes. I have not seen Professor Howe's theory myself, but I imagine that this theory is based on the waves travelling on the surface of the earth. Surely that could be extended to short waves travelling along the Heaviside layer. There is a point concerning interference bands which might be investigated. There are 50 to 60 metre stations using a pure D.C. supply with a master oscillator transmitter, and having a perfectly fixed wavelength without any possibility of variation, such as those used by the Naval Research Department in the United States, whose notes sound as if they were using unrectified 25 cycle A.C. This hum does not appear always, but it does on a good many occasions, particularly in certain localities. Possibly this also may be investigated, and it might be found that it is due to definite interference bands. The effect has not been noticed sufficiently long yet for any definite results to have been obtained. An interesting point, also, is that the stations which have been working in New Zealand are all, I believe, within 300 miles of the Antipodes of England, and there is certainly only one other really high power station in New Zealand, which is a good many miles further away. But that has not been heard yet, although I should think it most unlikely that it has not been on the job on one of the five mornings on which communication has been established up to the present. Time only will show, but I should not be surprised to find that we shall only be able to communicate with stations within a comparatively small area in New Zealand. I have had a letter from the North of England in which they say they cannot locate New Zealand up there. May be we are in some anti-nodal zone in which signals can be received from New Zealand, but that again is a matter which time alone can show.

(The conclusion of the discussion will be included in our next issue).

THE NEW POSTMASTER-GENERAL.

Sir W. Mitchell-Thomson, Bart., the recently appointed P.M.G.

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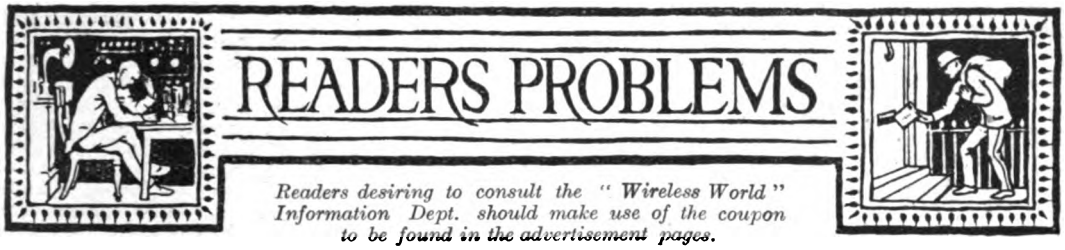

READERS PROBLEMS
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

A THREE-VALVE FRAME AERIAL RECEIVER.

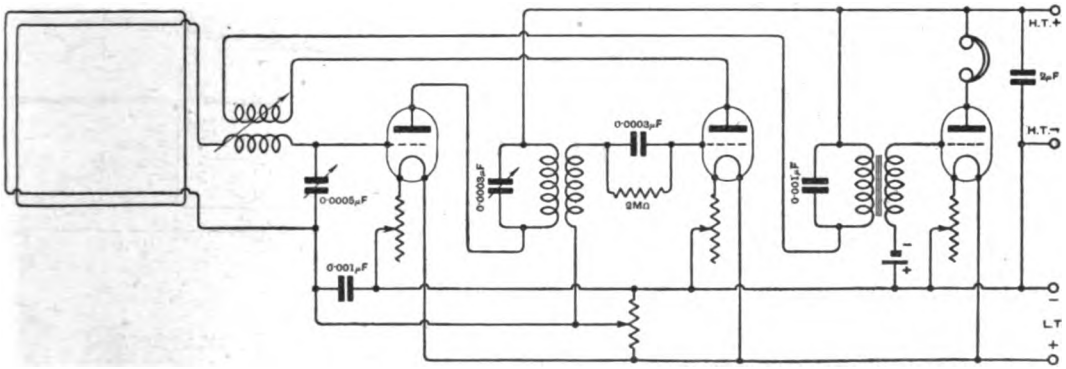
WITH careful adjustments, frame aerial receivers consisting of only two or three valves are capable of giving excellent results when used in conjunction with head telephones. It is not always necessary to use several stages of H.F. amplification with a frame aerial, and very good results have been obtained with a receiver of the type indicated in the figure below.

Three valves are used, the first operating as a high frequency amplifier, the second as a detector, and the third as a note magnifier. Tuned transformer coupling is employed between the H.F. and detector valves, with potentiometer control for the grids of both these valves. A reaction coil connected in series with the primary winding of the low frequency transformer is coupled to a small search coil in the frame aerial circuit. It is important to notice the position of this search coil. Many beginners connect the variable condenser across the frame aerial, leaving the search coil out of the tuned circuit. The tuning condenser should be connected across the frame aerial and the search coil, which are connected in series.

For the band of wavelengths between 300 and 500 metres, the frame may consist of seven turns on a former 4 ft. square. For best results the reaction coil will have a greater number of turns than the search coil, and the search coil may therefore be made the moving coil in the coupler. If the reaction coil is wound with from 50 to 100 turns of No. 26 D.C.C. on a former 3 ins. in diameter, the search coil may consist of 10 turns of No. 22 D.C.C. on a cylindrical former 2 ins. in diameter, mounted to rotate inside the reaction coil. A small basket coil having the same number of turns would do equally well for the search coil, and in this case the capacity between the two windings would be slightly reduced.

To reduce hand capacity effects in tuning, it may be an advantage to earth the negative side of the L.T. battery.

With a receiver of this type there should be no difficulty in receiving the transmissions from a main broadcasting station at distances up to 75 miles. Within a radius of five miles of the station it should be possible to work a small loud speaker.



A three-valve frame aerial receiver.

FUSE WIRES.

A READER asks whether it would be possible to use commercial gauges of wire for fusing currents as low as 0·2 of an ampere.

The construction of fuses for currents of less than 1 amp. is a somewhat delicate matter. This will readily be understood when it is realised that No. 47 S.W.G. copper wire fuses with a current of 1 amp. For currents of less than 1 amp. it would be best to experiment with narrow strips of foil, and it will be found that tin or lead foil will give best results. Both these metals are very malleable, and can be rolled to thicknesses considerably less than ·001 inch. The figures given below showing

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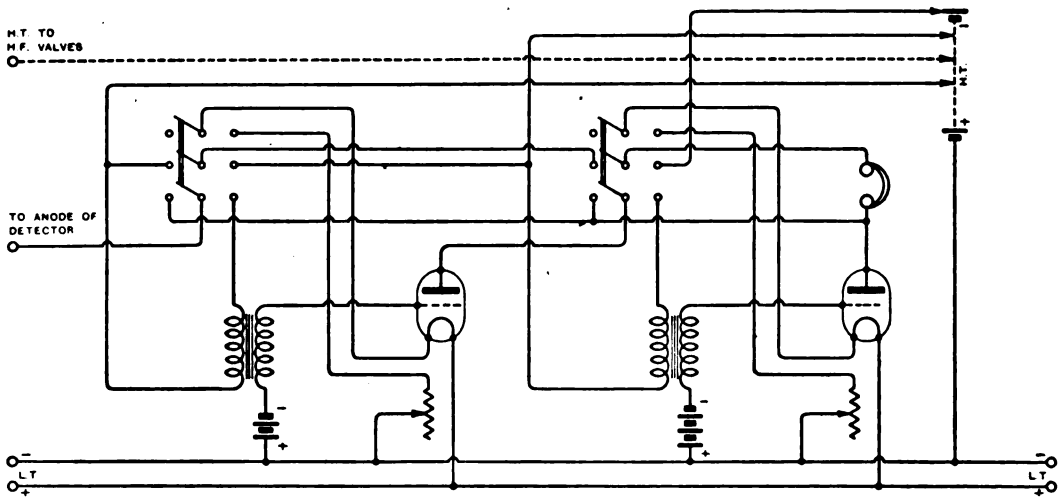
the fusing current for round wires of various diameters may be found useful in obtaining an approximate idea of the cross section necessary for currents of less than 1 amp. A curve could be plotted from these figures, and the cross sections for currents below 1 amp. could be obtained by extending the curve.

Fusing current in amperes.	Diameter in inches. Copper.	Tin.	Lead.
1	·0021	·0072	·0081
2	·0034	·0113	·0128
3	·0044	·0149	·0168

The thickness of wires for higher fusing currents may be obtained from the wire tables published by the London Electric Wire Co. & Smith's, Ltd., from which the above figures are taken.

conjunction with a frame aerial at a short distance from a broadcasting station. When difficulty is experienced in erecting an outdoor aerial, the problem can be solved in this way, provided that the distance from the station is not too great. We have ourselves had experience of satisfactory reception with an arrrangement of this kind at a distance of five miles from **2 LO**. The directional properties of the frame are very marked, and it is important to rotate the frame until the best position for reception is found. For the band of wavelengths between 300 and 500 metres, a frame consisting of eight turns on a former 4 feet square, tuned with a 0·0005 μF condenser, will give satisfactory results. The crystal and telephones are connected across the frame aerial and condenser in the same way that they would be connected across the A.T.I. in an ordinary crystal receiver.



A two-valve amplifier.

A Two Valve Amplifier.

THE connections of a two-valve amplifier suitable for addition to a valve receiver are given above.

It will be observed that the amplifier is connected to the receiver at four points. There are the plus and minus L.T. connections, and a single connection to the anode of the detector valve. If a reaction coil is used in the receiver, the connection of the detector valve will be made through this coil. The H.T. supply to the detector valve is taken from the amplifier H.T. battery, and if a separate H.T. tapping is necessary for any H.F. valves in the receiver, it will be convenient to provide a separate H.T. through the amplifier used.

Separate H.T. tappings are provided for each of the L.F. valves, and the three-pole change-over switches necessary under these circumstances have been included in the design.

Crystal Receivers with Frame Aerials.

IT is not generally realised that good results can be obtained when a crystal detector is used in

Aerial Insulation.

A CORRESPONDENT living in the country has written expressing disagreement with the paragraph on Aerial Insulation which appeared on page 57 of the issue of October 8th, 1924. He finds that cheap insulators are perfectly satisfactory, and does not consider that the expense of special types is justified in the case of receiving aerials.

We are quite willing to agree that this may be the case for aerials situated in districts where the air is comparatively pure, but in large towns it will be found that a thick gummy film makes its appearance on the insulators after they have been exposed for three or four weeks. If the leakage path over the insulators is short, this film will immediately give trouble, causing loss of signal strength, and, to a certain extent, selectivity. In town, however, the extra expense of insulators of large surface area is justified. The use of enamel covered wire for the aerial is an advantage, as the atmospheric deposit never actually comes in contact with the wire itself.

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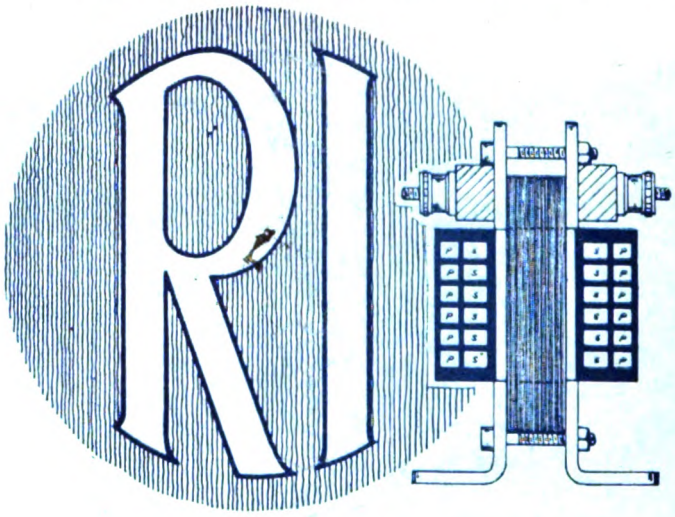

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THE WIRELESS WORLD AND RADIO REVIEW

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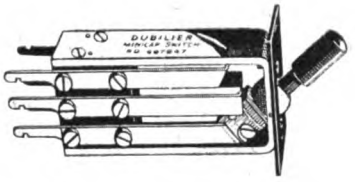

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

THE PROBLEM OF PATENTS.

By The Editor.

THE granting of a patent by the Crown is, we believe, the only surviving example of the former privilege, which at one time was vested in the Crown, of granting monopolies of all kinds to individuals or Corporations either as a reward for services or as a means of raising revenue. Perhaps this is why an erroneous impression is still quite common that, when a patent is granted, it constitutes a sort of guarantee by the authority issuing the patent that no other claim in respect of the same invention already exists.

It would undoubtedly be ideal if every application for a patent could be so thoroughly investigated and such a complete search made that the risk of a prior claim being in existence in a patent previously issued to another party would be negligible. Several countries have, however, long since found that they could not undertake to set themselves such a task and consequently in such countries it very often happens that patents are granted without any search being made or any investigation into the novelty of the invention nor even a consideration as to whether the arrangement described in the specification will function at all.

In England it is customary for the Patent Office to conduct a search and take what reasonable precautions they can to prevent overlapping of patent claims but at the same time the Patent Office does not accept any responsibility if it is found that it has inadvertently issued patents covering the same invention to different applicants.

Every development of science is accompanied by a considerable influx of inventors' claims to the Patent Office and this is especially the case where a popular application such as has been found in the use of wireless for broadcast purposes, is possible. In this connection it is of particular interest to observe the enormous increase which has taken place during the last two years in the number of patents taken out for inventions relating to wireless, particularly in regard to applications to broadcasting, yet if the actual utility of these patents were investigated it would probably be found that only a proportion of them are really of value. Considerable sums of money must have been expended since the introduction of broadcasting in obtaining patents or registering provisional applications for inventions which, in all probability, never did nor will have any intrinsic value.

We cannot help believing that quite a fair proportion of the inventions which can be placed in this category would never have been patented but for the ignorance of the applicant as to the novelty of what he believed to be his "invention," whilst many other applicants were probably under the impression that their claims to an invention would become indisputable the moment a patent could be obtained. The task of any Patent Office which attempts to make a search in the interest of would-be patentees must be an exceedingly difficult one in the case of wireless applications and whilst we deplore the fact that the Patent Office is not held responsible for duplicating patent grants for the same invention, we feel that they should receive every consideration in the very difficult task which they have to carry out, even under the present conditions of limited responsibility.

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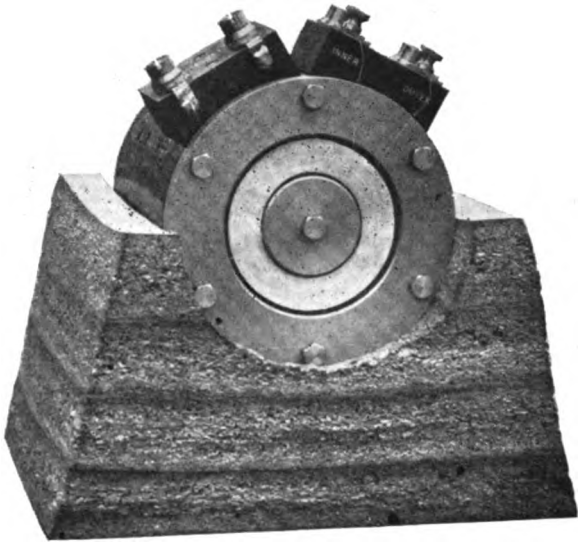

THE MARCONI-SYKES MAGNETOPHONE

A DESCRIPTION OF THE EQUIPMENT WITH DETAILS OF THE AMPLIFIERS.

Fig. 1. The Magnetophone supported on its cushion of sponge rubber.

This article, specially written for the *Wireless World and Radio Review* by Captain Round, gives for the first time a detailed description of the microphone and associated equipment which is used extensively not only for broadcasting stations but also for public speech amplifying, distributing and amplifying band music, etc.

By CAPT. H. J. ROUND, M.I.E.E.

THE advent of broadcast in England gave a stimulus to the production of high quality microphones and amplifiers for use in conjunction with them, and from the system, as a side issue, was evolved a high power loud speaker equipment to work either directly from these microphones and amplifiers or from gramophones or wireless.

The rights to manufacture, under the patent of Mr. A. S. Sykes, magnetophones of his type, was acquired, and after very considerable research a practical instrument was obtained which is in use in a great number of broadcast stations, and is also employed for public speech amplifying, amplifying of bands, or their transmission to other places, etc.

The magnetophone consists essentially of a cylindrical iron pot with a central core and a carefully arranged system of pole tips in between which is suspended an extremely light coil of aluminium wire supported on a backing of paper. This coil may be suspended in position in several ways.

One method which is not illustrated here is a trifilian suspension of silk thread, the thread being supported on sponge rubber pieces fixed in slots on the pole pieces.

The method illustrated consists in cotton-wool pads fixed with rubber solution to

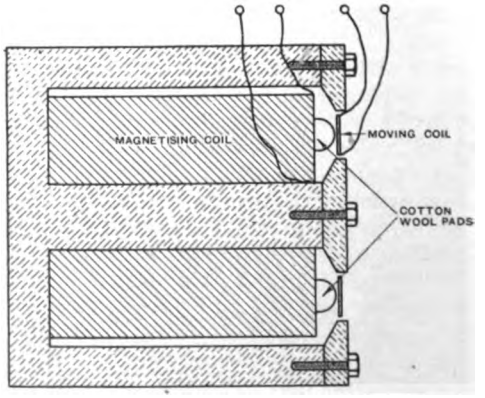

Fig. 2. A Section through the Magnetophone showing details of construction.

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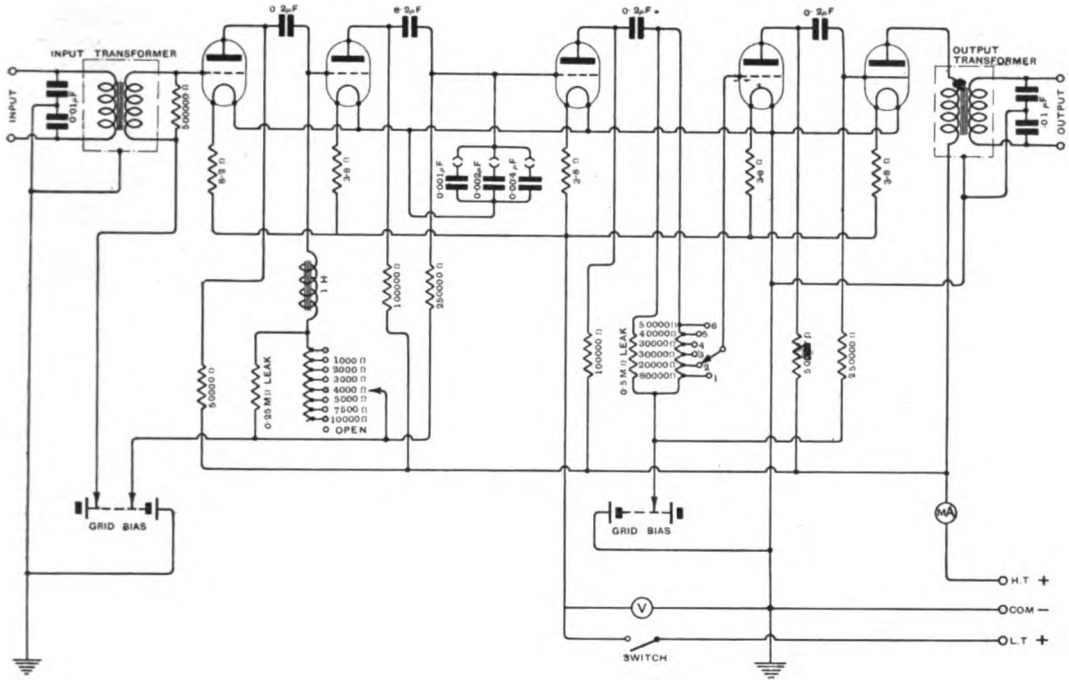

Fig. 3. Circuit diagram of the " A " amplifier.

the magnetising coil, whilst the moving coil is also fixed to these pads with rubber solution (Fig. 1).

Fig. 2 is a section through the whole instrument illustrating the arrangement of the magnetising coil. The coil normally takes 4 amperes at 8 volts and the flux density is about 1,500 lines to the centimetre. The case of the magnetophone is damped by a special arrangement to prevent it from vibrating as a bell.

The coil, which usually has a resistance of about 40 ohms, can be connected to well shielded lines up to half a mile in

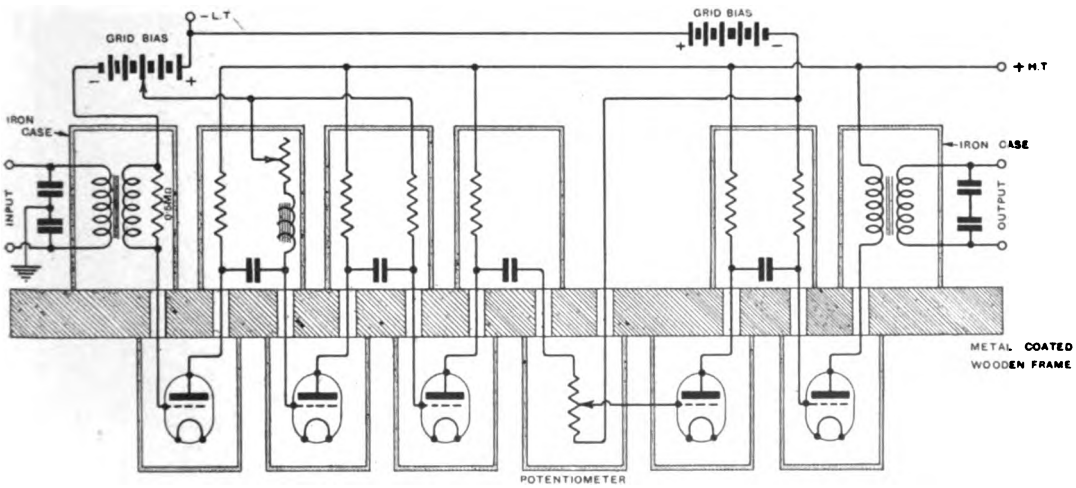

Fig. 4. Partial diagram of connections of the " A " amplifier illustrating the system of shielding.

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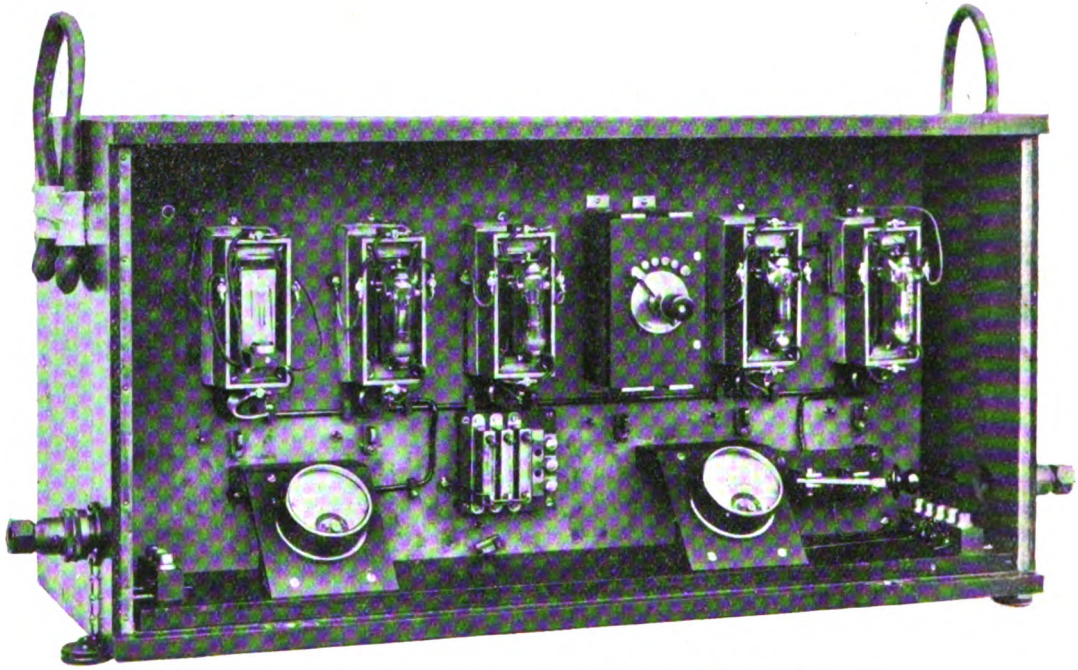

Fig. 5. A front view of the "A" amplifier with the covers removed.

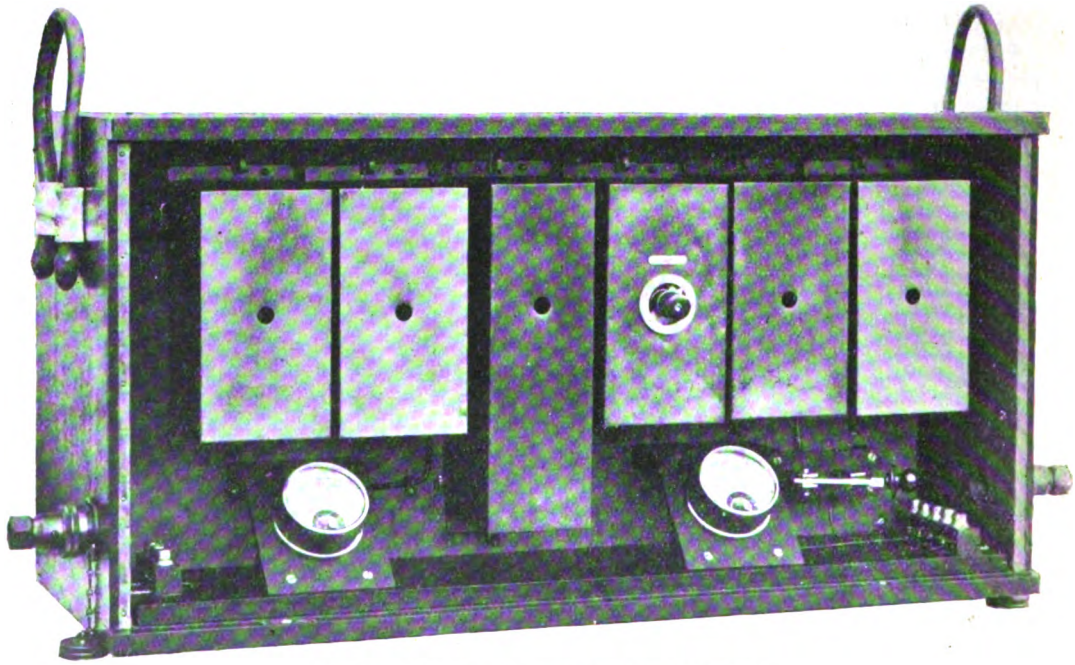

Fig. 6. The "A" amplifier (front) closed.

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length and then to the "A" amplifier, but on account of induction it is preferable to keep the "A" amplifier within about 100 ft. of the magnetophone.

The magnetophone line is connected directly to a transformer of the "Ideal" type, and the resistance of the magnetophone coil is arranged so as to give the necessary damping to the resonant secondary of this transformer, just as the valve connected to the primary of an "Ideal" intervalve transformer gives the damping to the secondary (see Figs. 3 and 4).

The "A" amplifier consists of a five-resistance stage amplifier, which is seldom

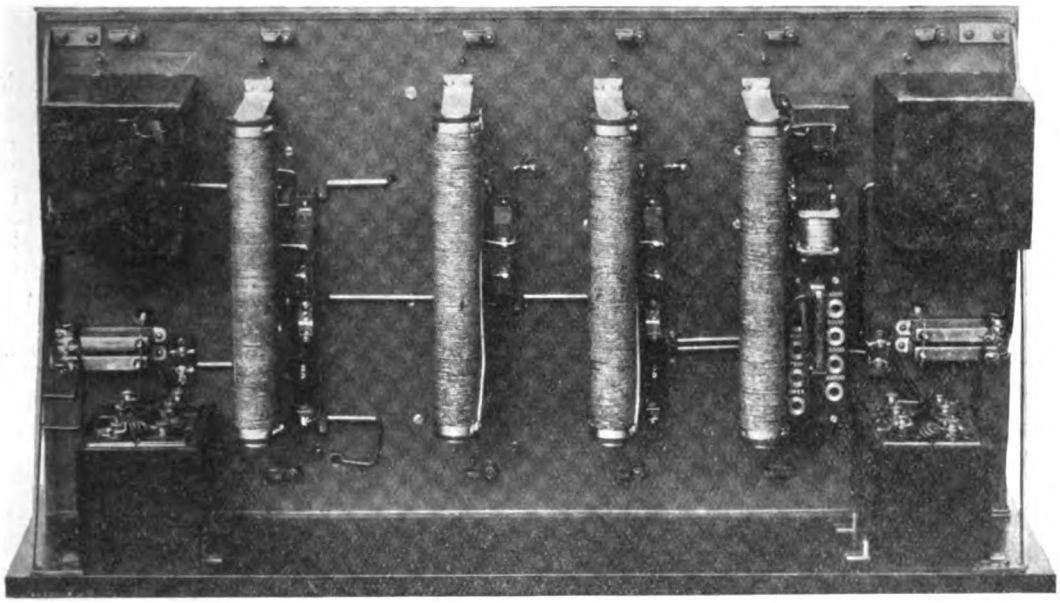

Fig. 7. A back view of the "A" amplifier with covers removed.

used all out, and a coarse potentiometer is arranged and set before any broadcast is put on so that no sounds likely to be produced can "blast" the amplifier. (The term "blast" is used to express the idea of carrying any part of the apparatus seriously beyond its linear limits.) The strength of signal at the end of the amplifier is ample to put over quite long telephone lines without induction trouble.

The amplifier has, of course, transformers for input and output, but the remainder is resistance coupled with two correcting arrangements. The first valve has a 1-henry inductance in its plate circuit, with a variable resistance in series up to 12,000 ohms (see Fig. 3). This gives a tone adjustment, in that decreasing this resistance steadily increases the ratio of high tone to low.

Across the second valve plate resistance is a variable condenser, variable in steps up to 0.007 mfds. This enables the high tones to be reduced in ratio to the low tones. These adjustments enable one to balance to some extent the sounds in different types of broadcast; for instance, in the studio little alterations from the normal straight magnification may be needed, but in a hall with a deep-toned resonance it may be advantageous to sacrifice some of the lower tones. Or, again, a land line may have a strong tone lowering effect, and this may be counteracted to some extent. A shunt condenser is always advisable, serving to reduce to some extent very high frequencies which are musically useless and "blast" the transmitter seriously. Handbells are particular examples which should be very carefully shunted as the harmonics are very violent. Gramophone records can be considerably improved by heavily shunting with capacity.

The "A" amplifier terminates in a transformer the ratio of which is arranged

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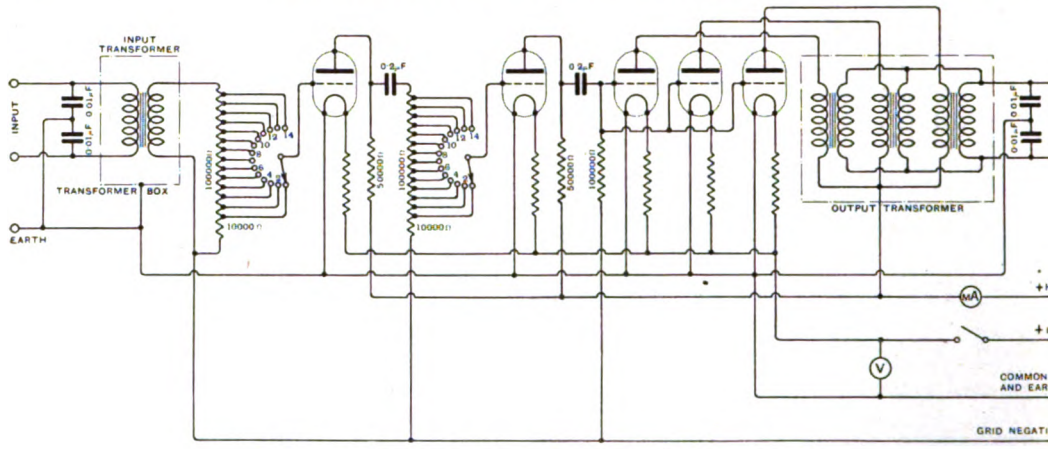

Fig. 8. Diagram of connections of the "B" amplifier.

to give the correct terminal connection for a 400-ohm line.

Fig. 3 is a full diagram of connections, and Fig. 4 is a partial diagram, showing the shielding system employed to prevent both reaction and induction.

Figs. 5, 6 and 7 are photographs of this instrument.

The "B" amplifier is chiefly a control amplifier. Two potentiometers arranged to work smoothly and to produce no electrical noise, enable it to be altered in strength from less than the incoming signals to about sixty times their strength.

Three output valves in parallel are used to give a great margin so that under no circumstances can this amplifier blast until the transmitter is very much overloaded. All possible blast is thus removed to the transmitter.

The curious arrangement of transformers in parallel at the end is an accident of design

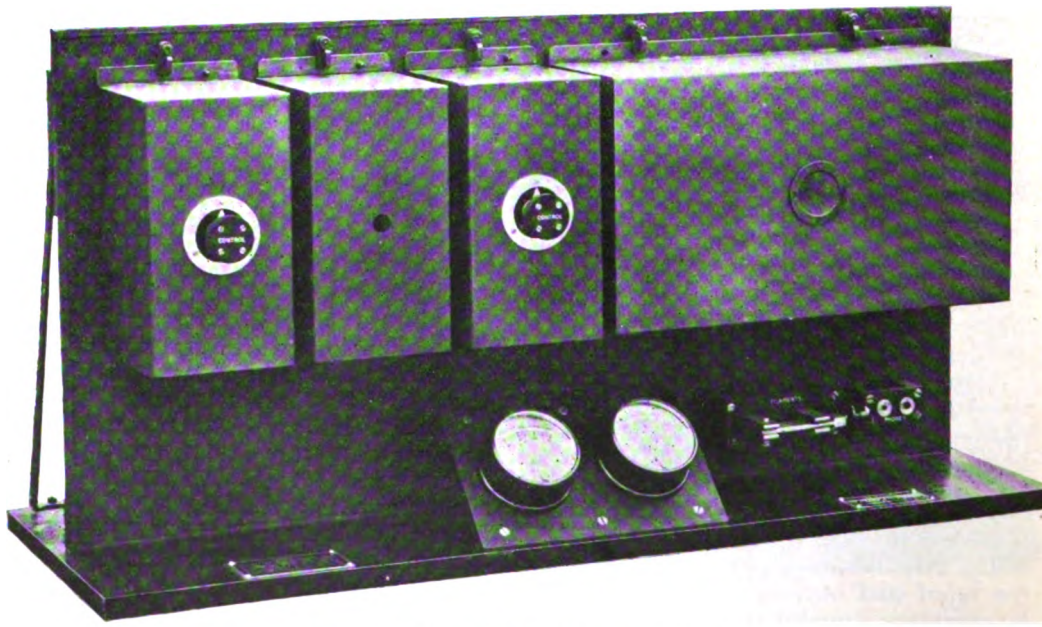

Fig. 9. The "B" amplifier (front view).

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in that the properties of these transformers were thoroughly known so that it was considered preferable to use them rather than spend a lot of time investigating a bigger one.

Again, the output terminal conditions are arranged for a 400-ohm line.

The input transformer is also arranged for this condition. A transformer for the wireless set is arranged to connect with the line. With a long line it is advisable to shunt this transformer with the correct shunt but on a very short line the shunt is not absolutely necessary, and when the " B " amplifier is used in connection with a power amplifier for the loud speakers this shunt is not used.

Similarly, the shunt on the input transformer of the " B " amplifier need not be used if the link to the " A " is a short one.

Fig. 8 is the ordinary diagram of connections of the " B " amplifier. Fig. 9 is the front view (closed) of the " B." Fig. 10 is the same instrument with the covers removed.

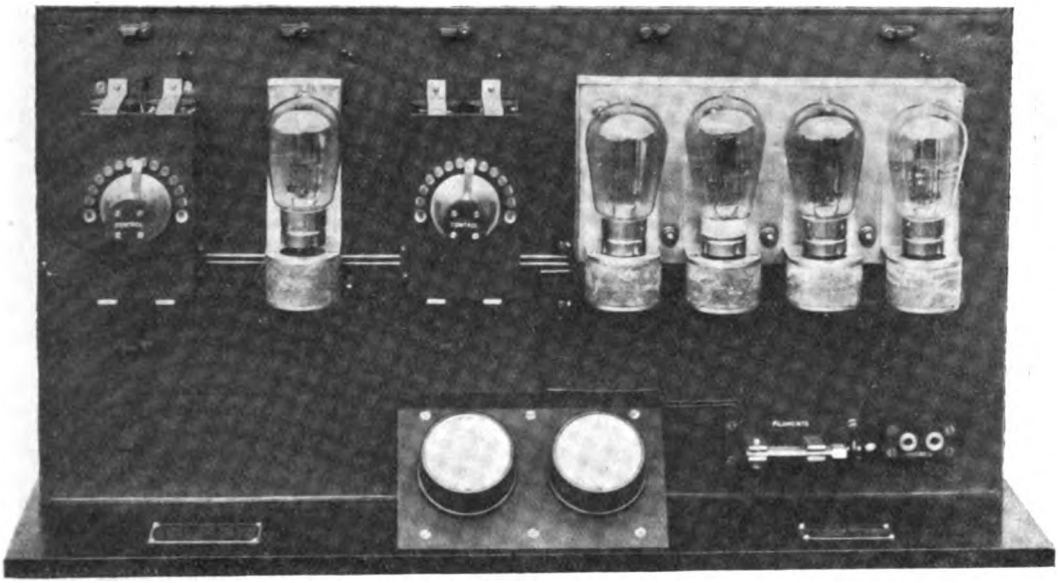

Fig. 10. The front of the " B " amplifier with covers removed

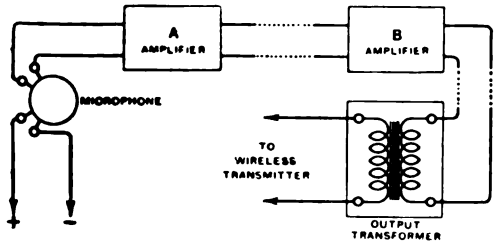

Fig. 11. A diagram showing the general arrangement of the magnetophone with its associated amplifiers connected to a broadcast transmitter.

Fig. 11 indicates how the magnetophone is coupled up to the broadcast transmitter through the complete system.

All the transformers used are of the " Ideal " type, investigated and developed by Mr. P. W. Willans, of the Marconi Company, and it is certainly a tribute to their aperiodicity over the whole frequency range that the London broadcast is transmitted through five of the transformers in cascade before reaching the high frequency transmitter.

I should, however, prefer to reduce this number if it were possible, but one has had to meet the engineering requirements.

B

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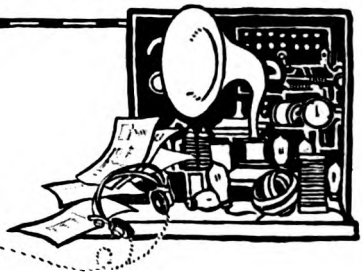
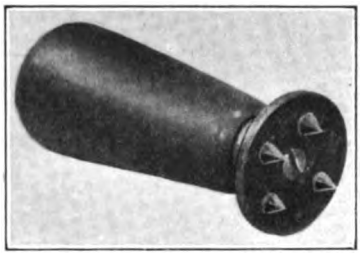
NEW APPLIANCES.



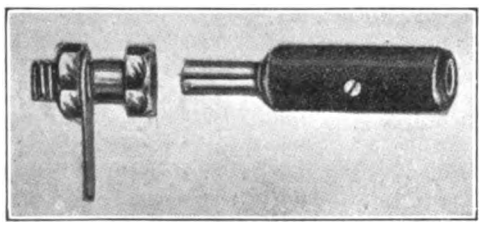
Valve Marker.

The use of valve stems in place of the moulded type valve holder is becoming perhaps more generally adopted by amateurs, partly on account of low cost, and also with the object of reducing capacity



Valve pin marker, made in good hard steel with handle mounting.

between the valve connections. To accurately set out the positions for the valve stems a template is essential, and a convenient form is manufactured by Messrs. V. R. Pleasance, of Sheffield, in which a hard steel disc is carried by a wooden handle of convenient shape, and fitted with four pin points. Pressed on to the face of a panel, the correct setting out is at once obtained.



Messrs. Pleasance's plug and socket and connector. It is supplied with a tag for making a reliable soldered connection without over-heating the socket.

The Igranic Freshman Condenser.

A new type of fixed condenser has this week made its appearance on the market. The plates, after mounting, are clamped with a metal tube under considerable pressure, and thus securely held the condenser maintains its correct capacity value. The form of mounting, as will be seen from the photograph, provides tag connectors, so that this condenser can easily be set up on the instrument terminals without soldering.

A new type of fixed capacity condenser. It is clamped securely in a piece of metal tubing.

Plug and Socket Connector.

THERE has long been a need for a plug and socket connector for use in particular in receiver construction. Its special application is, of course, changing the number of turns in circuit of an inductance instead of employing a multi-stud switch, as the latter is difficult to set up. It is useful also in place of terminals and for making all the circuit changes usually brought about by the use of switches. The Aermonic connector shown here possesses a good clean finish, and the plug makes a smooth fit in the socket, which is designed for panel mounting, and supplied with tag for making soldered connection.

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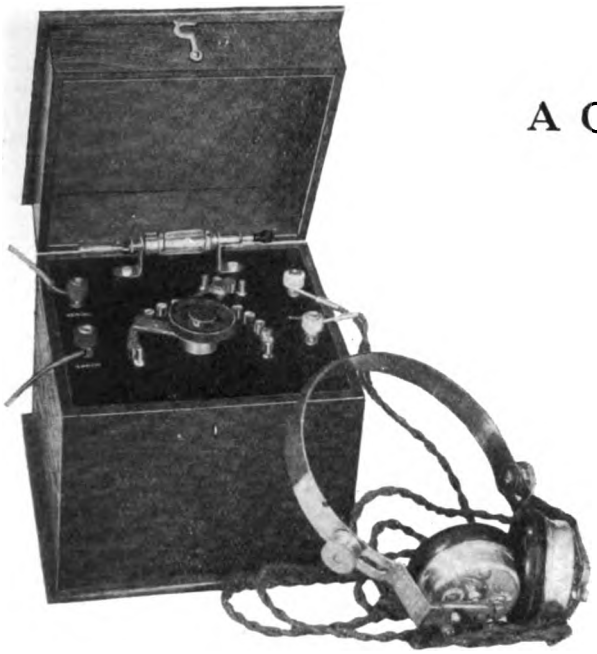

A CRYSTAL RECEIVER

250-2000 METRES.

Probably the majority of people interested in the broadcast transmissions own a crystal receiver. If the receiver is of an old pattern very likely it will not tune to the long wavelength of the high-power station. If it is difficult to make the necessary alterations it would be better to build the instrument described below, which is easily constructed and very effective.

By R. H. COOK.

THIS crystal receiver, which is illustrated above, is easily constructed, and will tune over the broadcast band of wavelengths and to higher wavelengths, including that of the high power broadcast station. The ideal broadcast receiver has only one tuning control, but as the receiver is to be employed to receive long and short wavelengths, provision must be made for cutting out the long wave tuning coil of the receiver if the receiver is to be effective on the shorter wavelengths. It is usual to employ a coil suitably tapped for the short wavelengths, and to add a coil, such as a plug-in coil, to receive the long wavelength broadcast transmissions. In this receiver the short and long wave coils are contained in the set, and by a neat switching device the long wave coil is automatically removed from the circuit when receiving short wavelength broadcast.

The connections are given in Fig. 1, where A is the arm of the tuning switch which makes contact with the studs connected to the tapped short-wave coil D, or the long wave coil E. Switch B is a dead-end switch. While switch arm A is being moved over the contacts connected to coil D, switch B is in the "off" position. When the switch arm is moved to the first stud connected to coil E, switch B is automatically moved to the "on" position. The switches

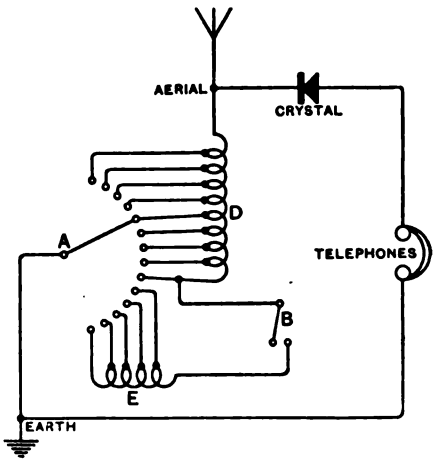

Fig. 1. *Theoretical connections of the receiver.*

may be seen by referring to the illustration below. It will be seen that the dead-end switch has a forked projection which is operated by the arm of the tuning switch.

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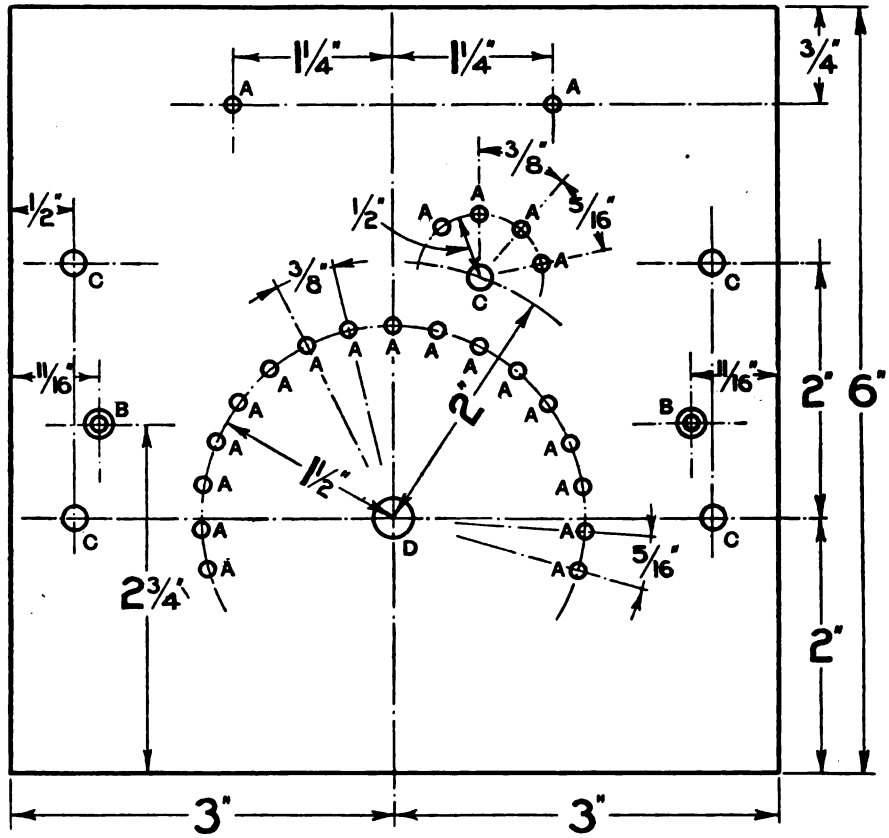

Fig. 2. Scale drawing of the ebonite panel. Drilling details: A, drill ⅛ in. hole; B, drill ¼ in. hole and countersink on front; C, drill 3/16 in. hole; D, drill ⅜ in. hole.

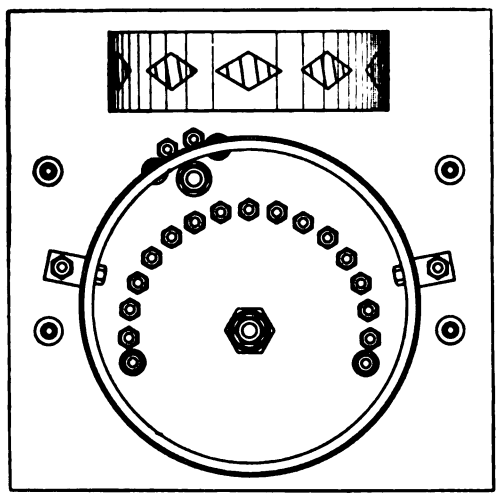

Fig. 3. Showing the underside of the instrument.

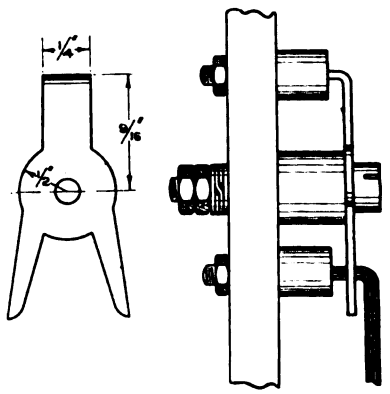

Fig. 4. Details of the "dead-end" switch.

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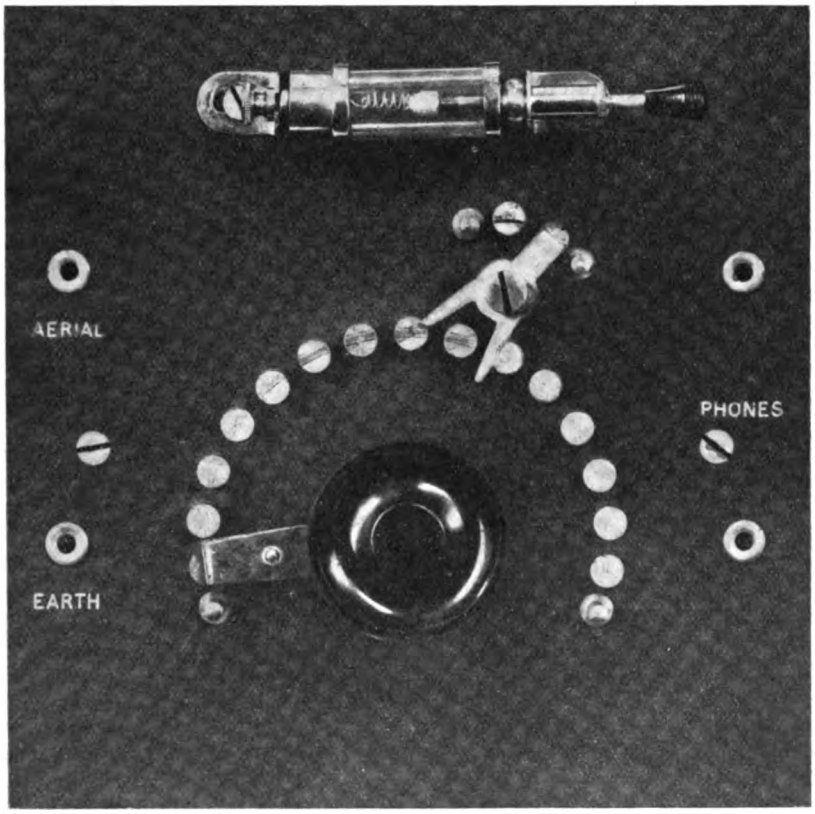
The single layer tuning coil D, Fig. 1, consists of a tube of cardboard or ebonite 4 ins. in diameter and 3 ins. long, wound with 60 turns of No. 26 D.C.C. There are nine tappings taken from every fifth turn from one end. This leaves a group of 20 turns between the end of the coil and the first tapping. Thus, referring to Fig. 1, the group of 20 turns is between the aerial winding the wire in the usual manner on a former 2 ins. in diameter to form a coil 1 in. wide. This coil has five taps about equally spaced.

THE PANEL.

A drawing of the top side of the panel is given in Fig. 2, and of the under side in Fig. 3. On the left-hand side of the panel



View of the panel of the set. The dead-end switch is below the crystal detector, and the forked projections are engaged by the arm of the tuning switch.

terminal and the first stud of the switch. As may be seen by referring to the figures, two brackets are employed to hold this coil to the panel. The wire should be twisted to form a loop at the tapping points, and the insulation removed so that the wires connecting the taps to the switch studs may be soldered.

A No. 200 coil may be employed as the long wave coil. This can be home made by

(Fig. 2) are two "clix" for the aerial and earth, and on the right-hand side two "clix" for the telephones. The crystal detector is mounted near the back edge of the panel, and the tapping switch in the centre. Details of the dead-end switch are given in Fig. 4. This switch has two studs, and the arm consists of a piece of No. 16 gauge brass cut to the shape shown in the figure. It will be noticed that the end which makes

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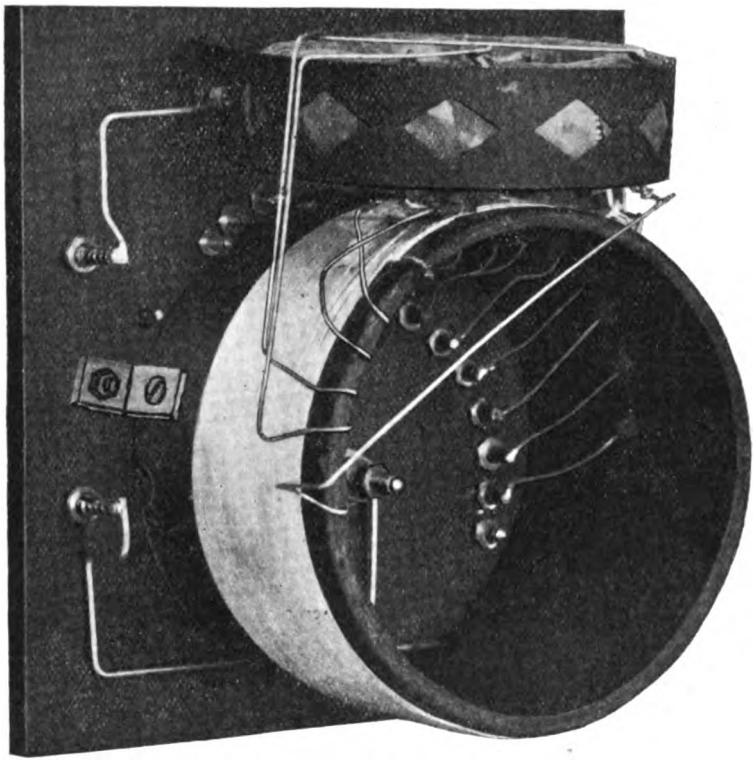

Showing the wiring of the coils to the switch, and the method of mounting the coils.

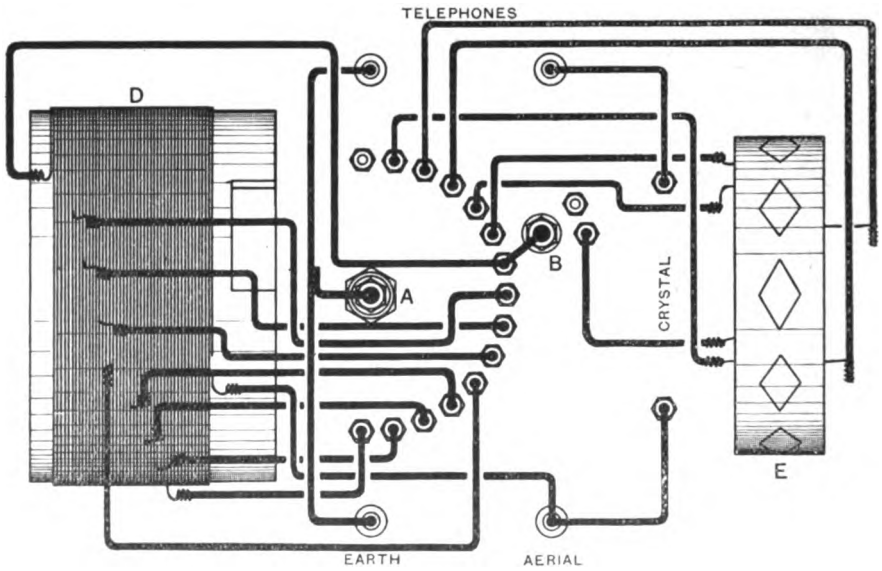

Fig. 5. Wiring diagram. The components are lettered to correspond with the lettering on the theoretical diagram of Fig. 1.

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contact with the studs is slightly bent over.

The panel consists of a piece of ebonite 6 ins. by 6ins. by ¼ in., and is drilled as shown in Fig. 2. The tapping switch employed has a radius of 1½ ins. If a different size of switch is used care must be taken when marking out the position for the studs. When the holes for the studs are drilled, the studs can be mounted and firmly secured. It may be necessary to touch up the surface of the studs to make them of even height.

The long wave coil is held by securing the ends of a fibre strap passed round the coil to the screws fixing the crystal detector.

WIRING.

The receiver should be wired with No. 18 or 16 tinned copper wire as indicated in the wiring diagram of Fig. 5. It will be noticed that the studs of the tapping switch are inside the bottom end of the cylindrical coil. The tapping wires should therefore be connected to the studs of the switch first, and then the tapping points on the coil.

THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

Tuning with Condensers of the Semi-Circular Vane Type.

THE ordinary type of tuning condenser has two sets of semi-circular plates, one set being fixed and the other rotatable. As the movable plates are turned the area of overlap changes.

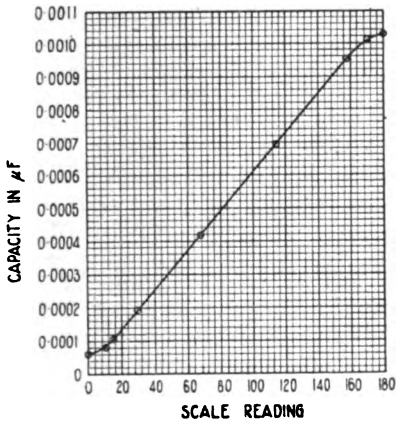

Fig. 1. The curve shows that, except for the extreme ends, there is a linear relation between the scale reading and the capacity of the condenser.

Now the area of overlap of the plates is approximately directly proportional to the setting of the scale of the condenser. That is, if the overlap when the condenser is set at 50 degs. is A sq. ins., when the condenser is set at 100 degs. the area is $2A$ sq. ins. Neglecting edge effects and stray capacities, the capacity of a parallel plate condenser is directly proportional to the area of overlap and therefore to the setting of the condenser. For instance, if the capacity is 0·0005 microfarad when set at 50 degs., it is 0·001 microfarad when set at 100 degs. Thus there is in practice almost a linear relation between the capacity and scale reading over a large portion of the range of the condenser.

Fig. 1 shows the result of plotting the values of capacity against scale reading on squared paper, and connecting the points with a line. The line connecting the points is not perfectly straight, but bends a little at the lower and higher scale readings. This is due to the construction of the condenser.

The Tuning Range.

When a condenser of this type is connected across a tuning coil (Fig. 2), the wavelength of the circuit may be varied between the limits of $1884\sqrt{LC_{min}}$ metres and $1884\sqrt{LC_{max}}$ metres (where L is the inductance of the coil in microhenries, and C is the capacity of the condenser in microfarads), provided there is no other capacity in the circuit. Thus, if the condenser has a minimum capacity of 0·0001 microfarad,

Fig. 2. A circuit consisting of a coil and a condenser only, and Fig. 3, a circuit with a coil, tuning condenser and a fixed condenser.

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and a maximum value of 0·001 microfarad, and the coil has an inductance of 253 microhenries, the wavelength range is approximately 300 to 950 metres.

In practice there is usually capacity in the circuit which is not localised in the tuning condenser. For instance, when the circuit of Fig. 2 is connected to an aerial, there is the capacity of the aerial in parallel with that of the condenser. If we assume the aerial to have a capacity of 0·0003 microfarads, we may for practical purposes represent the aerial circuit as consisting of a fixed condenser of this capacity in parallel with the tuned circuit, as in Fig. 3. The capacity range is now 0·0004 to 0·0013 microfarads, giving a wavelength range of approximately 600 to 1,080 metres.

Thus the wavelength *range* is considerably less when the circuit has a fixed condenser connected across it. When the tuning condenser alone was across the coil, the wavelength range was just over 3 to 1, but when a fixed capacity of 0·0003 microfarads is across the circuit the wavelength range is only a little less than 2 to 1.

It will therefore be seen that two circuits—for instance, an aerial circuit and a tuned anode circuit—will not tune over the same range of wavelengths or tune in the same wavelengths, even though both circuits have identical coils and tuning condensers when one circuit has a different fixed capacity to the other. The fixed capacity across the circuit may consist of the capacity of the coil and its mounting, the capacity between connecting wires, terminals, valve sockets and so on, or it may be the capacity of an aerial.

Tuning Curves with "Square Law" Condensers.

It is often said—sometimes by people who should know better—that if a tuning condenser of the "square-law" type is employed in a receiver, that it is only necessary to tune in two stations of known wavelength, plot the corresponding wavelengths and scale readings, draw a straight line between the points, and then read off the scale reading for other wavelengths.

This is not true, in fact this method is useless, as the curves of Fig. 4 show. A circuit was made up consisting of a No. 50 Igranic coil, an expensive "square-law" 0·0005 μF tuning condenser, and a valve detector. An accurate buzzer wavemeter was loosely coupled to the circuit, and the wavelength corresponding to various settings of the condenser obtained. The results are plotted in Fig. 4, curve 1. It will be seen that the curve is a straight line between 180

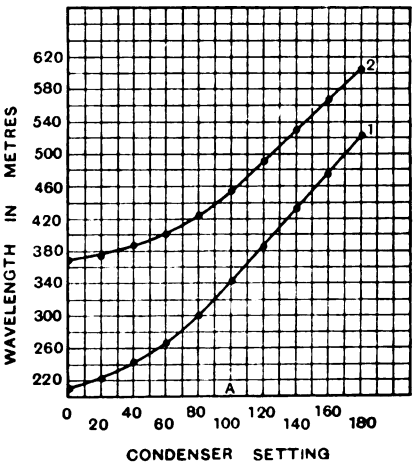

Fig. 4. Curves showing the relation between wavelength and the setting of a "square law" tuning condenser.

degrees and about 80 degrees. Between 80 degrees and zero the curve bends, and the wavelength is not directly proportional to the setting of the scale of the condenser.

Curve 2 shows the results obtained when a fixed condenser of 0·0002 μF* was connected across the circuit. The shape of this curve is different to the shape of curve 1, and the linear relation between wavelength and condenser setting only holds between 180 degrees and 100 degrees (A). The curve shows that a relatively large movement of the condenser is required to produce a small wavelength change at the lower end of the scale compared with the higher end of the scale.

The relation between wavelength and scale reading when "square-law" condensers are employed is therefore not linear, and further, the shape of the curve depends very largely on the amount of the fixed capacity in the circuit. Presumably the "square-law" condensers which may be purchased were designed to give the true "square-law" effect without considering the stray and other capacities of the circuits in which they are used.

These condensers will not give the "square-law" effect when connected in an aerial circuit, or in any circuit where there is appreciable stray capacity.

* Maker's rating.

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MEASUREMENT OF AERIAL CURRENT

DESCRIPTION OF AN IMPORTANT METHOD.

In this article the author discusses the behaviour of iron in high frequency circuits, and explains the method of designing and constructing iron-cored current transformers.

By N. W. McLACHLAN, D.Sc., M.I.E.E.

Shunted Hot Wire Ammeters.

IN comparing the strength of the signals received from various transmitting stations, it is essential that the aerial current shall be measured accurately. For currents up to 5 amperes, unshunted hot wire ammeters are very serviceable although in some cases there are appreciable errors. When shunts are used for these instruments, there is an error which increases with decrease in wavelength (increase in frequency) due to unequal inductance of the paths between the terminals through shunt and hot wire. By equalising the inductances of the paths, provided the inherent and earth capacity effects are negligible, it is possible to use shunts to increase the range of the instrument.

Hot wire instruments which will read 100 amperes or more can be obtained, but these costly accessories are usually very large and may be subject to an error which increases with decrease in wavelength.

Iron in H.F. Circuits.

The purpose of the present article is to describe another method—not novel, but neglected—of measuring currents of radio frequency, which is in general more accurate than the usual method when the currents are large. In power systems where the frequency is 50 cycles, the customary procedure is to measure large currents by means of an iron-cored transformer. It is usually regarded as unorthodox to employ iron in or near the radio frequency circuits of a transmitting set. The use of iron in H.F. circuits at high flux density or in an inductance where there is no transformer action due to a secondary winding is certainly a heresy. If, however, the iron is used at low flux density in a transformer, it can be shown that for given conditions the efficiency of the transformer, *so far as the iron circuit is concerned*, increases with decrease in wavelength.

Properties of Iron-Cored H.F. Transformers.

Suppose we have a closed iron circuit built up of insulated laminations, say rings of stalloy 0·25 mm. thick, uniformly wound with a single layer of insulated wire. Let us pass an alternating current through the winding and measure the voltages corresponding to various frequencies in a secondary coil wound over the primary.

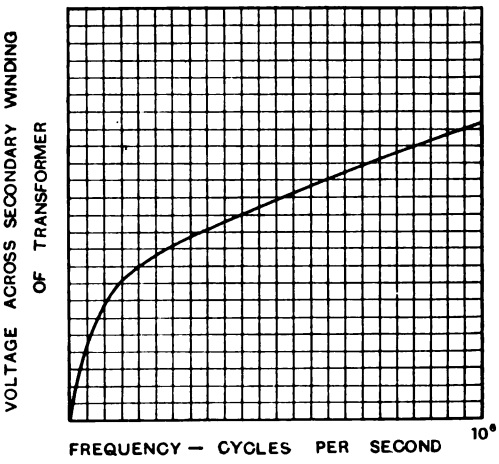

Fig. 1. Curve showing the relation of the voltage across the primary and secondary windings of the transformer to the frequency of the current. The current is held at a constant value.

When the current is kept constant the voltage across both primary and secondary windings will increase with frequency, as shown in Fig. 1. If, however, the primary current is regulated to give a *constant*

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secondary voltage, the relationship between current and frequency is of the form depicted in Fig. 2, and the loss-frequency curve is similar in shape to that of Fig. 3.

Thus we find directly from experimental evidence that (1) when the secondary voltage

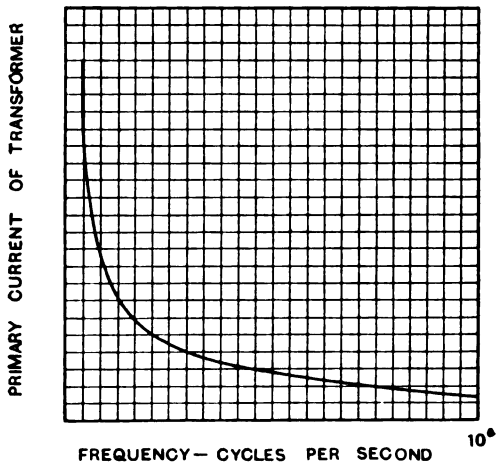

Fig. 2. If the primary current is regulated to give a constant secondary voltage the relationship between current and frequency is as shown by this curve.

is constant the current decreases with increase in frequency; (2) the iron loss decreases, and therefore the efficiency of the iron circuit increases with increase in frequency. In general, if the dielectric and copper losses can be kept sufficiently low, the overall efficiency of an iron-cored transformer increases with the frequency, *i.e.*, with decrease in wavelength.

Following the apathy of proper precedent in this country, the use of iron in radio engineering has been eschewed. But this has not been so in America and in Europe. For example, there are the Alexanderson, Latour and Goldschmidt high power radio-alternators, all of which use very thin iron laminations. Although alternators are defective from two main points of view, namely (1) only comparatively long waves can be used efficiently, (2) poor wavelength constancy compared with valve oscillators, their manufacture and use marks a definite epoch in the history of scientific achievement. Further uses of iron are to be found in frequency multipliers and in voltage transformers. In such cases the voltage per turn of winding is magnified manifold in virtue of the permeability of the iron, and care must therefore be exercised in keeping the dielectric loss of the insulating material adequately low to secure high efficiency and inexcessive heating.

The Accurate Measurement of H.F. Currents.

Some years ago, in conducting experiments with a Poulsen Arc, it was necessary to measure radio frequency currents from 1 to 10 amperes to an accuracy of 1 per cent.* No suitable hot wire ammeter was at hand, and so the method adopted was to use a Duddell thermoammeter reading to 100 milliamperes and an iron-cored current transformer with a ratio of 50/1 or 100/1, according to the value of the current to be measured.

This method can be extended to the measurement of much larger currents than 10 amperes. Transformers have been designed to measure currents exceeding 100 amperes with an error of less than 1 per cent. for a very wide range of wavelengths, say 100 to 20,000 metres.

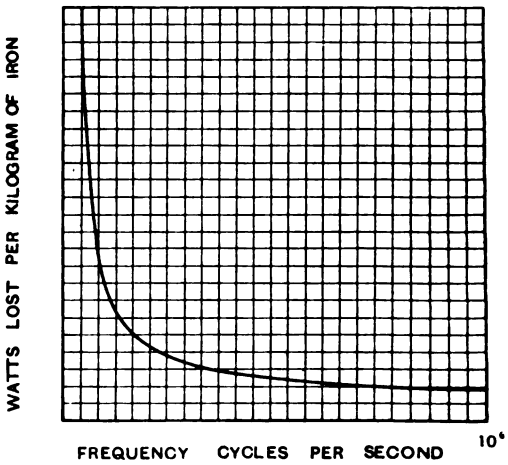

Fig. 3. A curve showing the relationship between the watts lost and frequency.

It is not usual to employ large currents at short wavelengths of 80 to 500 metres, so that the values on the short wavelengths would be less than 100 amperes. This may be more

* McLachlan, "Heating of Iron at H.F," *Electrician*, September 17th, 1915. McLachlan, "Behaviour of Iron at H.F," *Journal I.E.E.*, April, 1916. McLachlan, *Wireless World*, November and December, 1916.

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readily appreciated when we consider the energy radiated from an aerial at say 100 metres. By suitable design the radiation resistance can be made large in comparison with the dead loss resistance—*e.g.*, a vertical wire with no earth connection, operating at its natural wavelength, the maximum current being at the centre.

Taking a radiation resistance of 60 ohms (the radiation resistance of any vertical wire at its own wavelength is 80 ohms approximately), and an aerial current of 10 amperes, the power radiated is 6 kilowatts, or about half that radiated from the long wave transoceanic aerials. With 150 amps, the radiated energy would be 1,350 k.W.

(To be continued.)

VALVE TESTS.

THE M.O. D.E.7 VALVE.

The M.O. D.E.7 valve is a four-electrode valve—having two grids. Although the average experimenter does not ordinarily employ valves of this class, they may be used with good results in a number of circuits. Valves of this type are employed in certain commercial receivers.

THE D.E.7 is a four-electrode valve manufactured by the M.O. Valve Co., Ltd., Hammersmith, W.6, and differs from the three-electrode type in that an auxiliary grid is fitted between the filament and the main grid. The standard four-pin base is, however, still used, so that existing bases may be employed, and the connection to the auxiliary grid, (the one nearest the filament), is made by a screw terminal on the side of the valve cap.

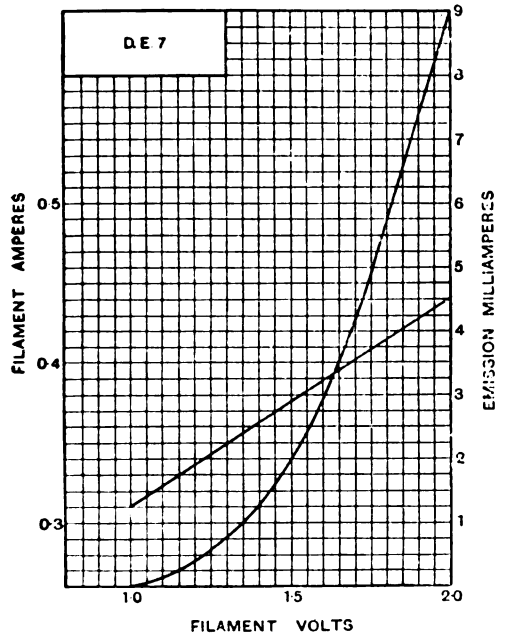

Fig. 1. Curves giving the relation of filament current and emission to filament voltage.

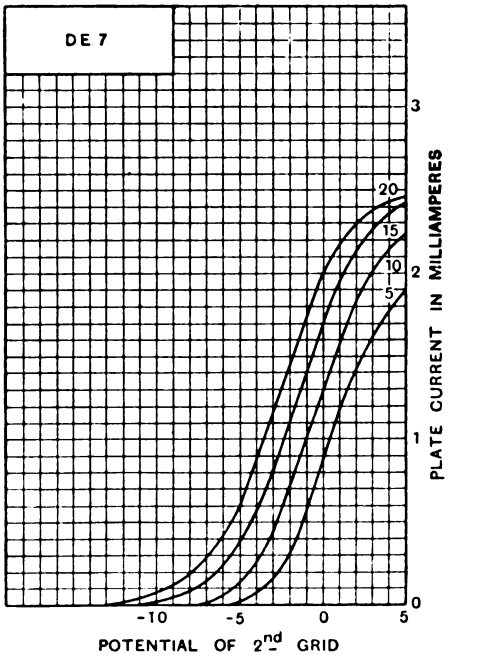

Fig. 2. Curves showing the relation of plate current to the potential of the second grid, the first grid having a fixed voltage of positive 15.

Our usual standard tests, as applied to three-electrode valves, are, generally speaking, not applicable to the four-electrode type, due mainly to the almost endless

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variety of possible curves. Again, the circuit arrangements for use with these valves are so varied.

Should four-electrode valves really become popular amongst amateurs, we will devise a standard test for them, but in the meantime we give a few curves from which their general characteristics may be obtained.

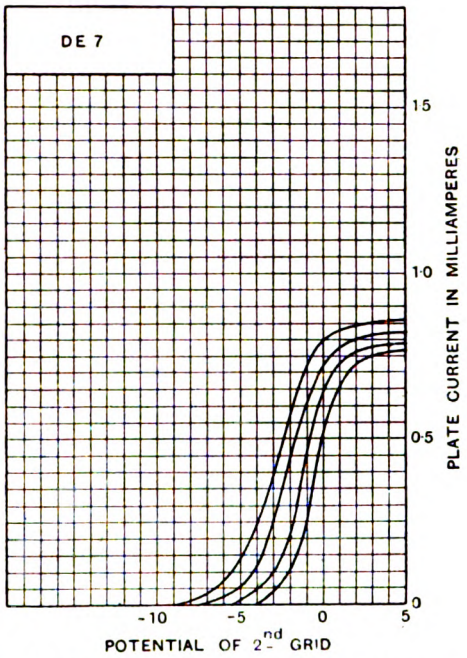


Fig. 3. The curves in this figure are drawn to a larger scale than those of Fig. 2. The first grid had a fixed potential of positive 6 volts.

The D.E.7 is rated as follows: Filament volts, 1·8; anode and inner grid volts, 6 to 15.

The filament characteristics of the valve under test are given in Fig. 1, from which it will be seen that at the normal rating the current is 0·415 ampere, giving a total emission of 5·7 milliamperes. Connected straight across a 2-volt accumulator, the emission rises to 9 milliamperes.

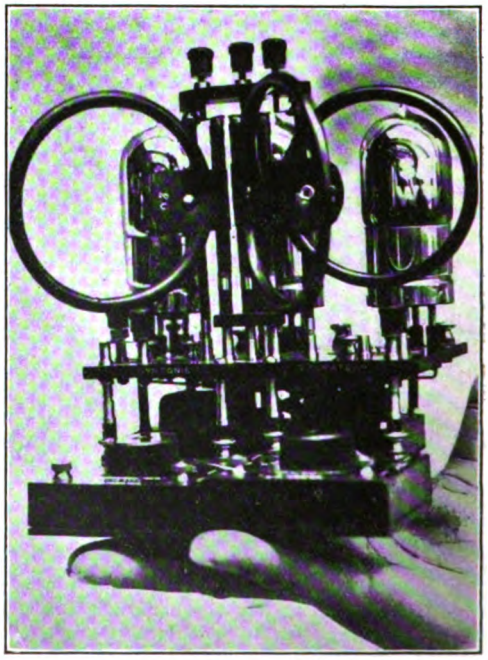
The curves of Figs. 2 and 3 show the performance of the valve when the second or outer grid is used as the controlling electrode, the first, or inner, grid being given a fixed positive voltage. These curves have the usual form, but it will be noted that the effect produced by increasing the voltage of the first grid is similar to that produced by increasing the filament current of a three-electrode valve.

The same values of plate potentials have been used for both sets of curves, viz., 5, 10, 15 and 20, but the potential of the first grid in Fig. 2 was 15, whereas for Fig. 3 it was reduced to 6.

From the curves of Fig. 3, we find the magnification factor to be 5 and the internal impedance 22,000 ohms, whereas, for the same value of H.T. the curves of Fig. 2 show the impedance to have dropped to 12,500 ohms, the magnification factor at the same time falling to about 4.

The foregoing curves indicate that the valve is one that will work particularly well on low values of plate potential, but it must be borne in mind that the output from a four-electrode valve must of necessity be rather lower than that from a similar three-electrode tube, due to losses in the first grid.

A COMPACT THREE-VALVE RECEIVER.



This set, which is of French design, is small enough to be held in the palm of the hand. Tuning is done by the two condenser dials on the base and the three coils.

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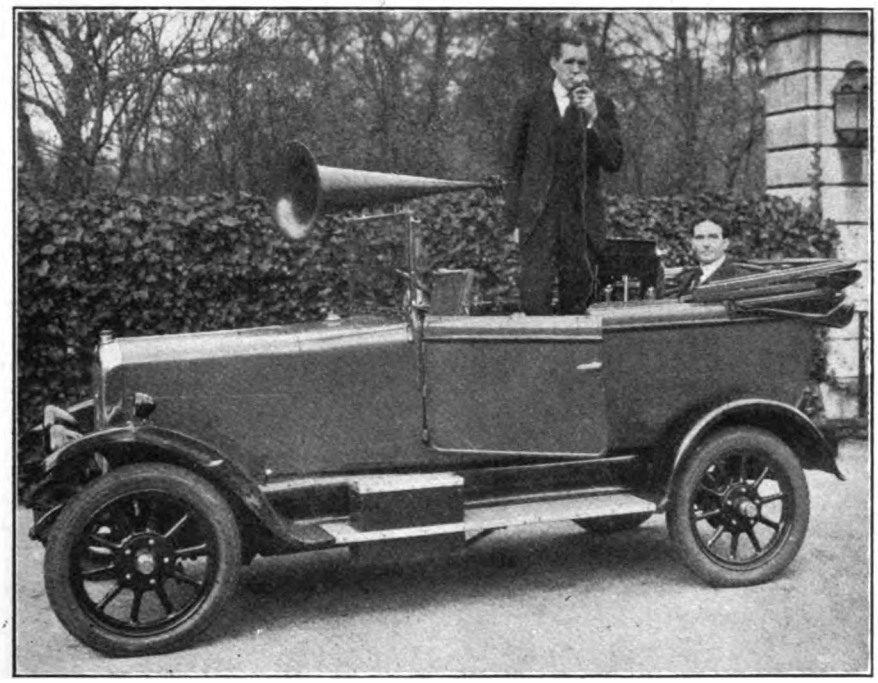
THE SPEECH AMPLIFIER IN POLITICS.

CAPTAIN IAN FRASER'S SUCCESSFUL OUTFIT.

CAPTAIN Ian Fraser, whose political victory in the constituency of North St. Pancras was referred to recently in our columns, attributes his success in a large measure to his use of a speech amplifier. By means of this instrument, designed by himself, he was enabled to address large crowds which would otherwise have been unapproachable.

The amplifier was constructed to Captain Fraser's design by Mr. A. E. Howlett. The loud speaker was fixed to the wind-screen of the car, as seen in the accompanying photograph, and consisted of a Standard Amplion model to which was fitted a pre-war Edison phonograph horn of very generous proportions. By means of a pivotting arrangement the loud speaker could be swung in all directions, so that all portions of the crowd could be reached at will.

The amplifier, hastily designed and constructed at the beginning of the campaign, made use of three valves. The microphone, of the ordinary Peel Connor solid back type, was connected in circuit with a few cells and the primary of a Marconiphone Ideal transformer having a 6 to 1 ratio. The output terminals of the transformer were loaded by shunting a resistance across the secondary terminals. This resistance was variable and had a range from 10,000 ohms to one megohm, and had the effect of considerably improving the quality, at the same time reducing the degree of amplification provided by the outfit.



How the amplifier was used. Captain Ian Fraser is seen speaking into the microphone. On his left is Mr. A. E. Howlett, who constructed the instrument to Captain Fraser's design.

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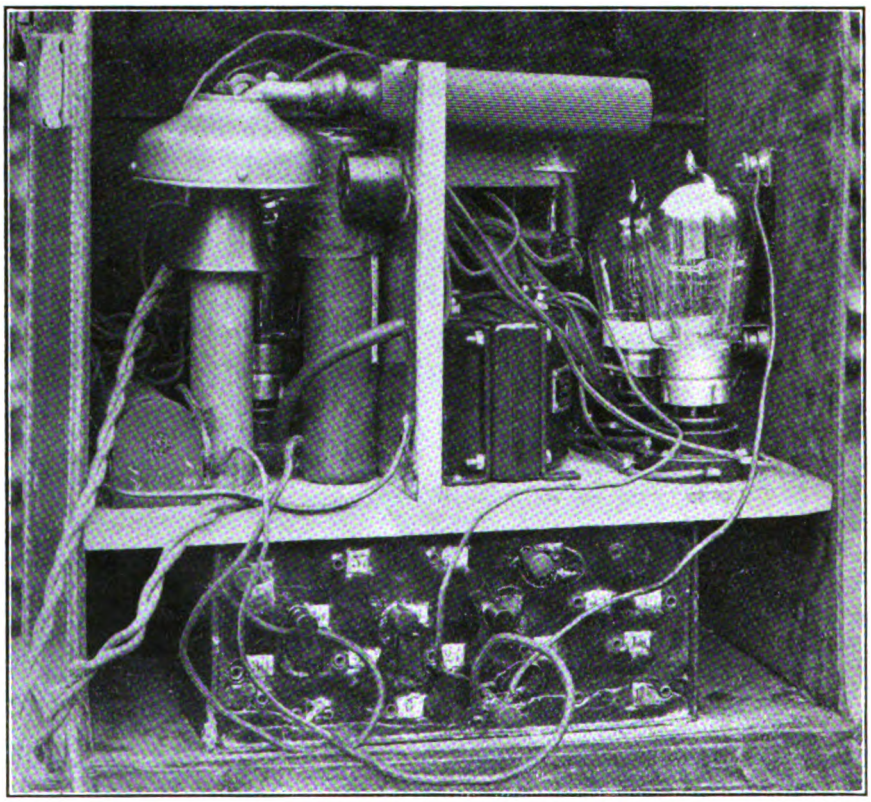
The first valve was of the L.S. 5 type, which operates with a filament battery potential of 4½ volts and passes a current of 0·8 amps, giving an emission of about 50 milliamperes. This class of valve was employed in consideration of the grid potential swing produced by the step-up transformer in the microphone circuit. The output of this valve was passed to a second valve of the same type through the usual resistance capacity inter-valve coupling, using an anode circuit resistance of 100,000 ohms. This valve was coupled to a further amplifying circuit by means of a transformer, and a valve of a special type was here employed as its grid potential fluctuated over a wide range. The valve was an L.S. 5A and had a lower impedance than the L.S. 5 type, by reason of the use of a grid having somewhat wider spacing.

The whole set was mounted in a portable case with the components distributed on either side of a wooden petition which was covered with copper foil. This was connected to the common negative point and earthed to the chassis of the car. For filament lighting the 12-volt car accumulator was used tapped at 6 volts. A H.T. voltage of 200 was taken from an accumulator which was mounted in a suitable box in the rear of the car.



The amplifier was constructed for rough usage, and gave excellent results throughout the campaign. Many of the components can be identified. The battery in the lower compartment provides the requisite grid bias.

In practice, the outfit proved remarkably efficient, tremendous volume being obtained from the loud speaker.

On one occasion Captain Fraser addressed an open air meeting of about 700 strong with perfect ease and it was evident that his speech was heard by everyone present.

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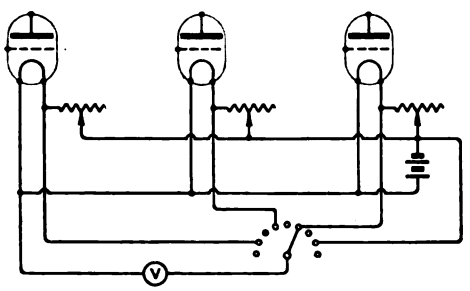
READERS' PRACTICAL IDEAS.

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Checking Filament Voltage.

FILAMENT brightness is very little guide that the correct current is being passed by the filament and the only method of making sure that the filament is not being over-run is to connect a voltmeter across it. On a single-valve receiver the fitting of a voltmeter does of course add to the cost and complication, but with a multivalve set the fitting of a voltmeter and switch is recommended. The voltage applied across the filament of any of the valves can be accurately determined and by carefully avoiding excessive voltage values the life of the valves will be appreciably lengthened.

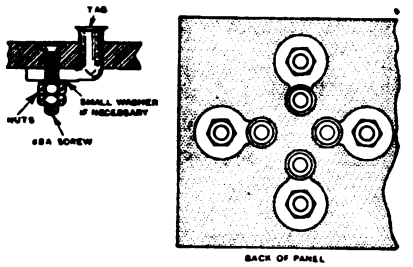
J. O. C.



Method of applying a voltmeter across the filaments of a multi-valve set.

Low Capacity Valve Holder.

IT may not be known to many experimenters that a good valve holder possessing low capacity between its contacts can easily be made up from the tag type of terminal connector. The drawing is almost self explanatory and it will be seen that the end of the tag is bent over at right angles and bolted to the face of the panel whilst the stem passes through a clearance hole. The holes



Valve sockets made from terminal tags.

for the sockets are best marked out with a valve template and drilled to hold the stem of the tag connector securely. By this means a good fit can be obtained with the pins of the valve.

D. O. B. G.

Economical Battery Charging.

ONE of the greatest difficulties met with by many wireless experimenters is that of the maintenance of the filament heating accumulator. When a continuous current supply is available the question of recharging is simple for it is only necessary to connect the battery to the circuit through a suitable resistance. This method, however, though simple is apt to prove somewhat expensive for nearly the whole of the current drawn from the mains is dissipated in heat in the resistance. A normal charging rate for a 60 ampere hour battery is 4 amperes. On a 200-volt circuit this is equivalent to

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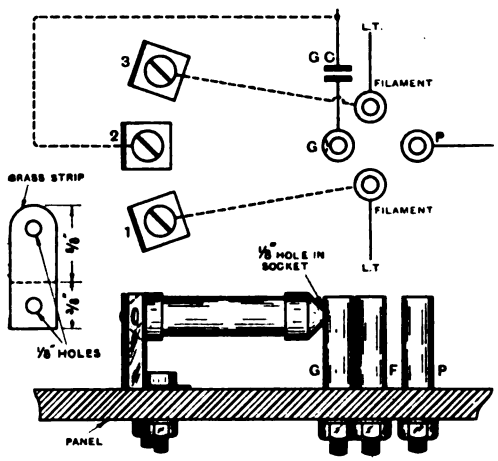
0·8 of a unit per hour or 8 units for a 10-hour charge. On a 240-volt circuit the energy consumed is proportionately higher, the cost of the charge working out at 9·6 units. At 5d. per unit the cost is respectively 3s. 4d. and 4s.

A better practice is to charge several small batteries in series and discharge them in parallel. A number of small cells may perhaps have a charging rate of 0·5 ampere and on a 240-volt circuit a 10-hour charge consumes 1·2 units, which costs 6d. on the same scale. After charging, the batteries may be connected up in two groups in series of six in parallel, giving a battery of 60 ampere hours.

A. J. B.

Mounting the Grid Leak.

ONE of the best methods for varying the value of the grid leak is by mounting it on the face of the panel and interchanging several resistances. In the accompanying diagram not only can this be done but by means of the clips 1, 2, and 3, the leak can



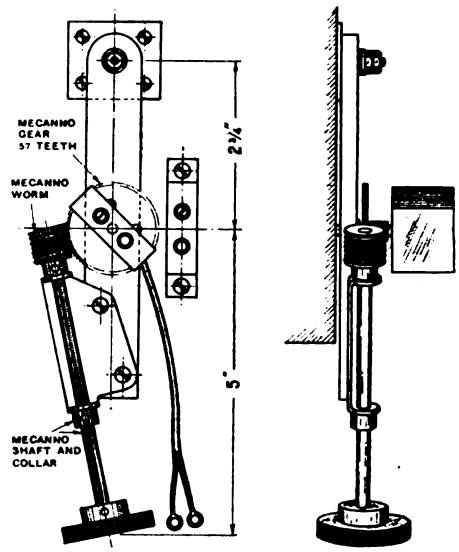
Simple method of changing grid potential.

be connected either across the grid condenser or to the low tension positive or negative leads. Thus the degree of self-oscillation in the receiver can be controlled by connecting the grid leak to the positive or the negative and the most suitable grid potential can easily be obtained to give rectification depending upon the type of valve employed.

E. M.

Coil Holder Design.

CRITICAL coupling between inductances carried by a coil holder is best obtained by a rotating action as well as by



A rotatable coil holder mounting.

altering the distance between them. One coil is secured to the baseboard while the other is carried on an arm pivotted to provide the necessary swing. The second coil holder is mounted above the small pinion which is operated by means of a wormwheel.

G. K. C.

Basket Coil Winder.

MAKING use of a borrowed basket coil former wind with No. 18 tinned copper wire to a depth of about ⅜". While the turns are still on the former, smear with flux and well solder the turns together, taking care not to secure the spokes to the winding. On removing the soldered winding, it is only necessary to prepare a set of pins by cutting up some suitable wire.

U. W.

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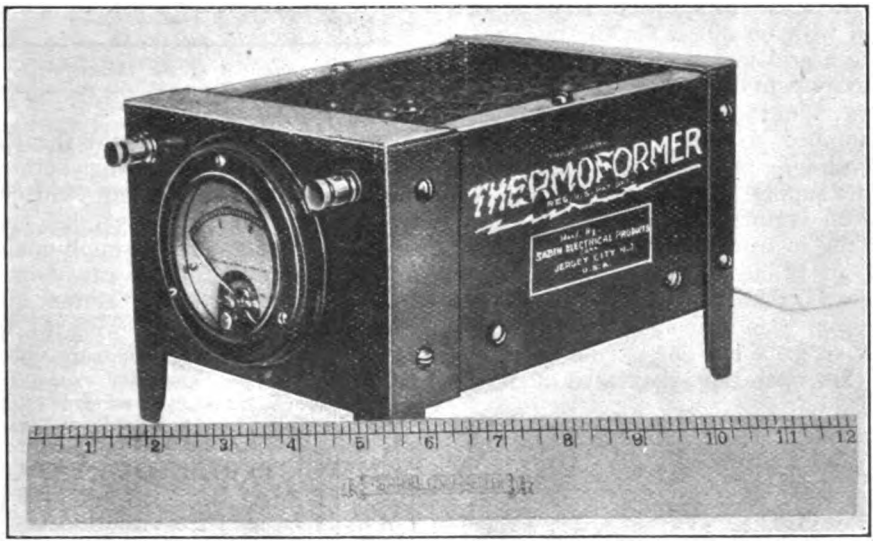
THE THERMOFORMER.

The problem of devising a method for deriving filament and plate current from alternating current supply has probably been solved in the instrument described here. It makes use of an entirely new principle inasmuch as current is produced by creating temperature changes at junctions of unlike metals. The old laboratory thermopile is probably well known to many readers; this new application is likely to centre interest in it as a method of producing the comparatively small currents required in wireless work.

A PERUSAL of the past volume of this journal will reveal that considerable space has been devoted to the development of rectifying equipment for use with alternating current mains, so that the alternating current supply can be used after rectification for filament heating and also for anode current in place of the usual high tension battery. Although many amateurs are using rectifiers of the electrolytic type for both filament heating and H.T. supply it may be stated here that the use of wet cells for rectifying purposes is only a proposition in the hands of the expert experimenter and that considerable technical knowledge and skill is essential to manipulate this sort of equipment successfully. It is, of course, a very messy process requiring constant attention. It may be said in general that rectifiers of the electrolytic type require careful maintenance to be of any practical utility.

Many types of vibrator rectifier have been developed and these serve their purpose excellently for the charging of both low tension and high tension accumulators, but of course, it is a great disadvantage to operate through a process of charging and discharging acid accumulators.



An instrument for generating filament and plate current by a thermo-electric process.

The device shown on this page marks a step towards meeting the needs of the amateur who only has available alternating current supply, whilst on the other hand it will operate equally well on direct current. It is of American origin and is marketed under the name of the "Thermoformer," and is the invention of Mr. R. A. Sabin of Somerville in co-operation with Mr. L. G.

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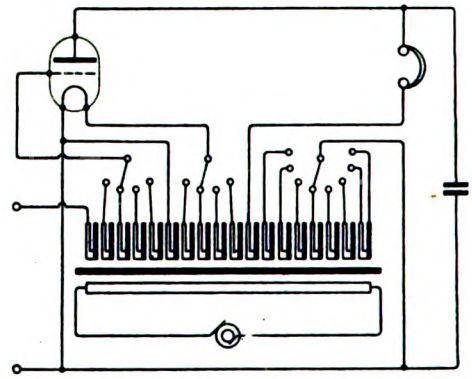
Pacent who is known to many experimenters in this country as a designer of wireless apparatus.

It makes use of the current produced when junctions between unlike metals are subjected to change of temperature. The instrument consists of a large number of thermo junctions which are heated by the usual type of heating apparatus designed for operation from direct or alternating current supply. It is well known that the potential output from a thermocouple is very small and thus to heat the filament of the 0·06 type of valve which requires a potential of about 3 volts, a thermoformer consisting of 32 units is necessary, whilst the amount of current delivered may be sufficient to operate three or more valves in parallel depending upon the size of the apparatus. The instrument is, however, not only designed for filament heating, but supplies plate current and in addition, some models are fitted with terminals for the purpose of providing a grid biassing potential.

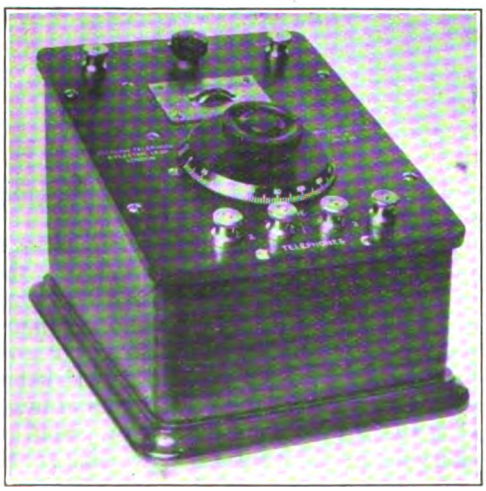
The accompanying circuit diagram shows the operation of the apparatus and by means of a number of multi-contact switches critical voltages for both filament heating and plate supply can be stepped off. A moving coil voltmeter is part of the equipment of the instrument, so that the output voltage can be accurately observed.

It might be thought at first that a device operating on this principle would occupy considerable space but one having an output suitable for operating six valve filaments of the 0·06 type, as well as supplying the necessary H.T. potential, occupies less room than a standard form of six-volt storage battery.

One great advantage of using an instrument of this sort is that the output is quite free from ripple and no smoothing apparatus is needed, whilst in operation it is entirely silent. There is little doubt that this type of apparatus for supplying both filament heating and plate current, will find considerable favour among wireless users who have alternating current supply mains available, whilst even in the case where direct current is fitted, the Thermoformer will still make an appeal owing to the convenience by which the necessary voltages can be obtained.



Circuit arrangement of the thermoformer in which provision is made for regulating the output voltage.



A NEW STERLING CRYSTAL SET.

As will be seen from the illustration, this crystal set follows in design other receivers of the Sterling Telephone Electric Company. The components are mounted upon a sloping ebonite panel fitted in a well-finished walnut case. It is a variometer tuned set making use of a new type of Sterling variometer, which is secured to the panel by one-hole fixing. The well-known Sterling automatic crystal detector is fitted. By means of a switch having contacts beneath the panel the necessary circuit changes are brought about for changing the wavelength from that of the short wave broadcast stations to 1,600 metres.

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UNSOLVED PROBLEMS OF WIRELESS.

By R. H. BARFIELD, M.Sc.

(*Concluded from page 256 of previous issue*).

DISCUSSION (*continued*).

Dr. R. L. Smith-Rose.

I think that Mr. Barfield is to be congratulated on having chosen such an opportune moment for giving this lecture. The progress of the discussion so far has amply justified it, but the chief merit of the lecture is in drawing attention to the uncertainty which exists amongst all those who have examined the problem in some detail, as to the actual mode of propagation of wireless waves around the earth's surface. It has become almost a dogma until recently to speak of the Heaviside layer and blame it for everything we could not understand in connection with wireless communication, but it is only when one examines the theory in the light of quantitative data, which are happily now being increased by a tremendous amount, that one appreciates the limitations that are applicable to the theory in the light of our present knowledge. It is easy enough to talk in a general manner of a layer 100 km. above the earth which will reflect waves, and to say that these arrive out of phase, resulting in decreased signal strength or in phase and so accompanied by increased signal strength and so on, but now that we have quantitative results we find that the theory is lacking in some details. I believe that the mathematical theory, as far as it has gone, is quite adequate, but there is really a lot of experimental data required to explain the whole position, and to decide the direction in which to expand the theory to account for the established facts. Therefore, the chief difficulty at the present time seems to be in the experimental direction, and in obtaining the quantitative data on the various effects which are now generally understood to occur. Pending the obtaining of that adequate experimental data, I think we should treat with some caution the theory as it stands, and not rush hurriedly to immediate explanation of barely established facts.

Mr. Blake has referred to some old experiment of Tesla's, and there is an interesting side issue here. Tesla suggested some scheme, as Mr. Blake has mentioned, of oscillating the earth at its natural frequency. Now, it turns out from calculations made by Professor Fitzgerald that the natural frequency of the earth, taken as an ordinary bi-pole Hertzian oscillator, is about one-seventeenth second when in free space. If, on the other hand, it is surrounded by a conducting shell corresponding to the Heaviside layer at a height of about 100 km., that frequency will be reduced to one-tenth second, while if the layer was only 56 km. high, the natural period would be one-sixth second. Now Tesla filed his patents, and everything was calculated on the assumption that the earth was going to oscillate at one-sixth second, so that although he did not, perhaps, make any use of the Heaviside layer, he apparently had some justification for assuming such a layer was in existence. I think the most acute problem mentioned by the lecturer to-night is the one relating to direction finding. It is comparatively easy to explain variations in signal intensity in long distance propagations, because there you are dealing with ordinary electro-magnetic waves as we understand them, that is, the type of wave shown in diagrams which appear in the text books in which the electric field is vertical to the earth's surface, and the magnetic field is horizontal and at right angles to the direction of propagation. In daylight and under ordinary conditions that arrangement of the waves holds, and those of you who use frame coils know that in order to get the maximum strength of signal you put the plane of the frame pointing towards the transmission station so as to get the greatest possible linkage with the magnetic field. During the night time, however, the magnetic field or the horizontal component of the magnetic field is not at right angles to the plane of propagation, and in cases which are not at all unusual the induced E.M.F. in the frame is unaltered by rotation of the frame through 360 degrees. It is therefore evident that the magnetic field is equal in all directions, and the net result is that the magnetic field is no longer linear, but must be circularly polarised as a rotating component. To change the polarisation of the wave propagated at the receiver it is necessary to introduce a different type of wave from that which will explain the other three phenomena, *i.e.*, one in which the magnetic field has a component in the plane of propagation. There are various modifications of the Heaviside layer theory to explain the arrival of such a wave, but there are difficulties in visualising the way it arrives at all. In many cases a wave polarised in the manner I have described must be considerably stronger than the ordinary wave with which we are dealing, and which produces the other effects. It is interesting to note that a proposal has already been made to construct a model of the earth about one-thousandth full size, and have a sliding Heaviside layer which could be put in operation as required, everything being reduced in proportion. The suggestion is only a suggestion so far, and there are many obvious difficulties in putting it into practice. With regard to the means by which waves can arrive at the Antipodes or any point on the earth, I do not quite see that the theory recently put forward in any way alters what we knew before. If you admit that there is a conducting shell surrounding the earth, then these waves will always concentrate at a point at the Antipodes, whether they slide along

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the earth or along the layer to get there, or whether it is accomplished by reflection. There will be a point where the waves will converge and produce a strength greater than at some places not so far round, but there will be many other points at which the field is considerably stronger than the field which is experienced, say, half way round the earth; and I do not think it is necessary to assume that there is only one point in New Zealand which can receive from a station in London on, say, a wavelength of 100 metres.

Captain M. A. Ainslie.

I had forgotten that the Antipodes are so near to the point with which communication has been established. Under the circumstances, any great circle drawn through London would very nearly pass through the point of reception, and if the point of reception is 300 miles from the Antipodes, the difference between the longest and shortest possible paths is only 600 miles. I should imagine that local conditions, such as distribution of land and water, or of light and darkness, might easily cause the most effective path for the waves not to be along the great circle at all; it might hardly touch any land at all, but might, for example, cross the Isthmus of Panama. Moreover if there are several receiving stations all within about 300 miles of the Antipodes, and only 20 or 30 miles apart, the great circles through them and London —even assuming the waves to follow the great circle—would be widely different. I had an idea that the Antipodes were a good deal further from New Zealand than 300 miles, so this point might be borne in mind.

Mr. F. L. Hogg.

Mr. Orbell, of New Zealand, has mentioned something of interest to me in regard to the Bordeaux station. He says that the long wave transmissions from Bordeaux are received extraordinarily well by all amateurs around the Dunedin district, where the stations which have been working on short wavelengths are located, but in the northern part of New Zealand, where the other stations are, Bordeaux is rarely heard under any circumstances whatever. This is rather what I suggested may actually be found to be the case.

With regard to the fourth New Zealand station, this has recently been received very weakly indeed on two of the best nights for communication with the others. Enquiries show that he has been working regularly. This station, so weak here, is one which has been heard in many parts of the U.S.A., and is, in fact, by far the loudest there, and is actually using more power than any other in New Zealand. This is what one would expect if the Antipodal idea is responsible for the results.

Mr. P. R. Coursey.

Before asking Mr. Barfield to reply, I would just like to say a word or two about the question of the Antipodes. I was a little surprised at the statement that it is only 300 miles away, because I had the impression that it was much farther, and, basing my belief on the great circle maps which have been prepared, I thought the Antipodes of London was considerably off the New Zealand coast altogether. That being so, there is a considerable difference between the two directions. If I remember rightly, the nearest circle direction from London is in a north-easterly direction over Norway and Northern Russia, and then across part of Asia, and skirting Australia to New Zealand. That is my recollection of the great circle maps plotted with London as the centre. The tests which have been carried out by the French Government seem to show an increase of signal strength as the Antipodes is reached, and certainly indicate a very marked increase of signal strength of a local character in the proximity of the Antipodes. That, of course, applies solely to long wave transmission, and may not apply at all to the shorter waves we are now dealing with. That is obviously a matter which can only be found out by further investigation over a much longer period. Certainly it would seem very doubtful that the points from which signals can be received should be so localised as has been suggested. If such were the case it would very much reinforce one's belief in the theory of strengthening the signals at the Antipodes. It will, however, require very much further data before we can come to any further generalisation.

Mr. R. H. Barfield, replying to the discussion, said:—

Dr. Eccles referred to the important part which may be played by the upper atmosphere in screening us from the effect of powerful stray waves. I might also point out that it would have an equal effect in preventing our communicating by wireless with the other planets, since it would be an effective screen. I do not know how we shall penetrate this layer.

In reply to Mr. Blake I think the Tesla idea of surface waves being created by the transmitter is accounted for by the diffraction theory. I think it is all worked out in that theory so that the possibility of such waves along the surface of the earth accounting for propagation has really been dealt with in that problem.

With regard to Captain Ainslie, I certainly think interference is a possible solution of the fading problem, but I do think that the important thing at present is to obtain more experimental confirmation of these theories so that we can decide between the possible alternatives.

Mr. Robinson and Dr. Smith-Rose pointed out that on any theory, the Antipodes should certainly be the point where the waves concentrate. If there were no diffusion at the Antipodes we should get the same current in the receiving aerial that the transmitting aerial is sending out.

I think, in reply to Mr. Child, it would be very interesting indeed to go on decreasing wavelength until we find the optimum value obtainable. Every encouragement should be given to go to shorter and shorter wavelengths.

ANOTHER NEW ZEALANDER.

NZ IDQ, a New Zealand amateur hitherto unheard in this country, is reported to have been received by Mr. W. H. Bungard, of Wymondham, on the morning of November 13th. Audibility was about R 3 on a four-valve receiver (1 – v – 2), but no definite message was logged owing to atmospheric disturbance. Mr. Bungard believes that the New Zealander was calling **G 2 NM**.

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THE TRANSATLANTIC TESTS.

THIS opportunity is taken of inviting our readers to forward to us as promptly as possible, reports on the reception of American and Canadian broadcast stations taking part in the Transatlantic tests.

The transmissions, as previously announced, will be made from America and Canada from 3 to 4 a.m. G.M.T. on the mornings of the 24th to 30th November inclusive. Special programmes are being transmitted from most of the high-power stations on the other side of the Atlantic, whilst speeches by eminent men, directed particularly to Europe, will be made. Mexico is, in addition, participating, and from the broadcasting station there a speech recording the voyage of Columbus is to be sent out particularly for the benefit of Spanish-speaking people of Europe.

All Europe is taking part in transmitting back to America from 4 to 5 a.m. on the same days, and as we have already mentioned, and in accordance with the programme published generally in the press, the British broadcasting stations will transmit from 4 to 5 a.m. on the mornings of the 25th, 27th and 30th, different stations taking part on different days. In addition to piano, gramophone and speeches organised for the other days of the transmission, a special organ recital from the Shepherd's Bush Pavilion, London, will be included, in addition to the speeches, on the morning of the 25th. It has been arranged that, as the British stations start to transmit, the hour from Big Ben will be broadcast at 4 a.m. and again when the stations close down at 5 a.m. Nearly all the broadcasting stations on the Continent are taking part and these will be transmitting on the mornings of the 24th, 26th, 28th and 29th November, from 4 to 5 a.m. These stations include: Radio Paris, l'Ecole Supérieure, Petit Parisien, Brussels, Madrid, Rome, Hamburg, on their usual wavelengths, Koenigs Wusterhausen (on 2,800 metres), Stockholm and Switzerland, whilst others are likely to take part although no definite information is available to publish.

It is hoped that all those who avail themselves of this exceptional opportunity for listening-in to American broadcasting and to European stations will take whatever precautions are possible to avoid causing interference with other listeners through re-radiation, and will forward reports on reception, indicating the items received, to assist in verification.

CAPTAIN ECKERSLEY EXPLAINS.

Sooner or later it was likely that Captain Eckersley would be called upon to give some explanation for statements appearing in his recently published book,* which might be considered as belittling the value of the amateur.

Captain Eckersley took the opportunity of forestalling criticism when on the occasion of his address on Tuesday, November 18th, to the Transmitter and Relay Section of the Radio Society, he touched upon this matter before giving his address on "The Control Room at **2 LO**."

Captain Eckersley said that it was unfortunate that a part of his book would perhaps not be altogether agreed with by those present at the meeting. He said he wished to emphasise that in all the articles he had written and in his book he had endeavoured to put before the amateur and the public his own point of view and that in the book he had said that he did not think that amateurs as amateurs had really contributed towards the science of radio telephony. He admitted that the statement required some explanation and he stated that a little further on in the book he expressed the opinion that the value of so many experimenters to the community, lay in the possibility that many of them might become good professionals. He stated that this summed up the whole point, because if a man who takes up wireless purely as a hobby is fortunate in striking upon a good invention, he immediately becomes a professional.

Captain Eckersley said he recognised the work of amateurs in the past in finding out various troubles and stated that he intended to recommend to the B.B.C. that more should be done to repay the debt owed to the amateur.

*Captain Eckersley Explains (Wireless Press, Ltd.)

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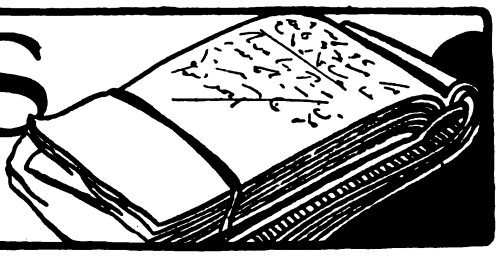
NOTES & NEWS



Since the opening of the Nottingham Relay Station the number of broadcast licences issued in the district exceeds 18,200.

* * * *

The Soviet Government would appear to be short of land stations, judging from the announcement that the Russian ship "Ermak" (**RBW**) has been stationed at Leningrad to operate as a coast station.

* * * *

Signor Ermanno Fiammo, the inventor of a system of wireless control, has successfully demonstrated in the Gulf of Spezia that his apparatus is immune from jamming.

* * * *

The Borkum Riff Light-vessel will shortly commence a direction and distance-finding service by a simultaneous emission of fog radio signals and submarine bell signals.

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COPENHAGEN TESTING.

The Copenhagen broadcasting station is continuing its tests on 750 metres. Regular transmissions are also carried out on 471 metres on Sundays, Wednesdays and Thursdays.

2 OD's AUSTRALIAN SUCCESS.

Reference is made in the T. & R. Notes appearing on another page, to the feat of Mr. E. J. Simmonds (**2 OD**) in accomplishing two-way communication with an Australian amateur, **A 3BQ**. This was carried out on the evening of Thursday, November 13th, at 6.40 (G.M.T.); the Australian was heard transmitting a CQ call on 75 metres, with a rough A.C. note. **2 OD** called him at 6.50, and received the reply "R. o.k. QRK, but QRN." Great difficulty was experienced in receiving **3 BQ** owing to local heterodyne interference. After **2 OD** had again transmitted times of suitable schedules, which were apparently received, **3 BQ's** signals faded completely at 7.15.

Mr. Simmonds immediately cabled to Australia and received the following reply from Melbourne:

"CONGRATULATIONS TIMES CORRECT—HOWDEN."

British amateurs will unite in congratulating **G 2OD** and **A 3BQ** on being the first amateurs to communicate between Britain and Australia.

Mr. Simmonds also worked on November 1st with **Z 2AC**, a New Zealand amateur, who had not hitherto been communicated with from this country.

ACD, BOLOGNA.

Mr. Adriano Ducati, the well-known Italian amateur (**ACD**), who recently undertook a voyage to South America, transmitting on board ship with the call sign **1 HT**, would be glad to receive reports from British amateurs who heard his signals. He is now back in Italy and will shortly resume operations with the original call sign **ACD**. His address is: 3 Via Garibaldi, Bologna, 29, Italy.

U.S. NAVAL RESEARCH SHORT WAVE SIGNALS.

Until further notice the U.S. Naval Research Laboratory (**NKF**) at Bellevue, Anacostia, D.C., is transmitting on 54 metres on Mondays, Wednesdays, and Fridays at the following times: 8 to 8.10 p.m., 9.0 to 9.10 p.m., 10.0 to 10.10 p.m., 11.0 to 11.10 p.m., Eastern Standard Time. (E.S.T. is five hours behind G.M.T.).

Dr. Taylor of the Naval Research Laboratory, emphasises the need of more short wave observers and will gladly welcome reports at the above address.

FRENCH BROADCASTING FEARS.

The control of broadcasting in the interests of national safety has recently been causing some anxiety to the French Government, and as a precautionary measure, the Sureté Générale has increased its staff. The reasons given are that with the million wireless receivers now in use, possibilities exist of the dissemination of harmful political information; and that Bourse and market quotations, particularly adverse, are liable to be propagated and used by unscrupulous foreigners to the detriment of the franc.

U.S. AND GERMAN PATENTS.

An echo of wireless in the war was provided by the action of the U.S. Navy Department on October 30th, in deciding to issue licences to sixty independent radio manufacturers under 129 German patents seized by the Alien Property Custodian at the outbreak of hostilities.

The majority of the patents were originally owned by the Telefunken Company, and included the well-known Wilhelm Schloemlich and Otto Van Bronk patent covering tuned radio frequency.

In 1919, under the *Trading with the Enemy Act*,

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the Alien Property Custodian sold these patents to the Secretary of the U.S. Navy.

According to legal opinion, this latest step of the Navy Department will completely change the complexion of patent litigation in America.

MISUSE OF CALL SIGN.

A complaint of the illicit use of his call sign reaches us from Mr. Stanley Ward **(2 QS)**, of Brixton, London, S.W. From reports received it would appear that the culprit is located in a district bounded by Manchester, York, Hull and Sheffield. Mr. Ward trusts that the publication of this fact will have the desired effect.

IMPORTANT TRANSMISSIONS FROM ARGENTINE.

Mr. J. C. Braggio, the well-known Argentine amateur, who is at present in England, has supplied us with some important information concerning transmissions now being carried out by his father, Mr. Carlos Braggio from **DA 8 (ex CB 8)**. These transmissions are sent out every morning from 4.30 to 5.30 G.M.T., and will continue until the end of the year. From 5.30 onwards, Mr. Braggio will listen for replies. He uses C.W. on a wavelength of 120 metres.

Amateurs who succeed in hearing these signals are requested kindly to report direct to Mr. Carlos Braggio, Alsina, 412, Buenos Aires, Argentine.

EVENING RECEPTION OF AUSTRALIA.

Consistent daily reception of New Zealand amateurs from November 10th onwards is reported by Mr. D. B. Knock **(6 XG)**, who also claims to have received the Australian **A 2CM** on the morning of November 10th, using a detector and one note magnifier.

On the evening of November 13th, at 7 o'clock, he was also successful in receiving the Marconi "Beam" transmission from Australia, on 90 metres. Calling "**ICCM** de Fisk," the station was easily readable, and appeared to be using full wave rectification.

A further report of the reception of Australian amateurs has reached us from Mr. J. Allan Cash **(2 GW)** of Lymm, Cheshire, who heard **A 3BQ** in the early hours of November 13th, and **A 2ME** on November 14th. The latter station was also heard by Mr. J. L. Heaton-Armstrong, of Wimbledon Park.

NEW ZEALANDERS HEARD IN BELGIUM.

Both **Z 2AC** and **Z 4AA** have been heard by a Belgian amateur. On the morning of October 22nd, the Brussels amateur **P 2**, tuned in these stations, the former on 75 metres, and the latter on 80 metres. Although the signal intensity in each case was only R3, both stations were easily readable. Our correspondent reports that on the same night he "logged" 112 U.S. amateurs between 60 and 80 metres.

JOHANNESBURG ACTIVE

High praise of the Johannesburg broadcasting station is expressed by Mr. L. C. Hughes, President of the Transvaal Radio Society, in some interesting notes he has forwarded to us concerning broadcasting activities in South Africa.

Johannesburg **(JB)**, which commenced operations in July, has an aerial 75 feet above a seven-storied building, and in equipment is almost a replica of the Birmingham station. It transmits on 450 metres, and has some excellent distance records to its credit. For instance it has been heard on a single valve at Cape Town, 1,000 miles; Walvis Bay, 850 miles, and Durban, 400 miles; while with two valves it has been received at Bukama, 1,165 miles distant. Mr. Hughes advises British amateurs wishing to attempt reception of **JB** to listen nightly between 4.30 and 8.30 (G.M.T.).

MADAGASCAR WIRELESS SERVICE.

At present wireless communication between France and Madagascar, and France and French Western Africa, is one-sided. Messages are accepted

H.R.H. The Prince of Wales opened the reconstructed section of the Watling Street between Dartford and Rochester on Wednesday, November 19th, the proceedings being broadcast. The microphone can be seen on the right.

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for transmission from France, but cannot be transmitted in the opposite direction. On November 27th the Minister of Colonies and the Under-Secretary of State for Posts and Telegraphs will formally inaugurate the service in both directions between Paris and Antananarivo, and Paris and Bamako.

RADIO EXHIBITION IN IPSWICH.

An exhibition which proved a great success, both from the point of view of the trader and of the amateur, was held at Ipswich on November 11th and 12th, under the auspices of the Ipswich and District Radio Society.

In addition to a good representation of the local wireless trade, amateur exhibits were well to the fore, exemplifying all types of receivers. These varied from the smallest of crystal sets to handsome cabinet receivers which reflected great credit on the abilities of their constructors. An important feature of the Exhibition was the demonstration of broadcast reception on loud speakers.

A COMPREHENSIVE WIRELESS CATALOGUE.

One of the fullest and most carefully-produced catalogues of wireless apparatus is that issued by Messrs. A. J. Dew & Co, of 33-34 Rathbone Place, Oxford Street, London, W.1. The book is of particular value as a means of reference to the wireless trader, for whom it has been specially prepared.

Radio Society of Great Britain.

An ordinary meeting of the Society will be held at the Institution of Electrical Engineers, Savoy Place, London, W.C.2, at 6 p.m., on Wednesday, November 26th, when L. B. Turner, M.A., M.I.E.E., will deliver a lecture entitled "Wavemeters."

* * * *

A meeting of the General Committee of Affiliated Societies will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, on Saturday, November 29th, at 3 p.m., at which various important questions affecting the amateur movement will receive attention.

* * * *

T. &. R. NOTES.

I am very pleased to be able to supply with these notes a photo of Mr. Ralph Slade of Dunedin, New Zealand, best known by amateurs as **NZ 4 AG** (see next page). I have also been fortunate in receiving a visit from Miss Margaret Ford, also of Dunedin, and a great friend of Mr. Slade. It will doubtless interest a good many readers of the *Wireless World and Radio Review* to know that Mr. Slade is twenty years old, and is engaged in the Postal Telegraph services in Dunedin. I am also given to understand that it is almost entirely due to Mr. Slade's untiring efforts that amateur radio in New Zealand has arrived at its present most efficient stage, and that he is partly responsible for the building of **4 AK** and **4 AA**.

The most important radio amateur news of the week is **2 OD's** two-way communication with **A 3BQ** of Australia. Mr. Simmonds is the first European amateur to link up with Australia, and deserves our heartiest congratulations. It is good to know that his painstaking efforts have been so suitably rewarded.

Some new distant stations have started up in the shape of Chilian amateur transmitters; one of these with the call sign **9 TC** gives his position as Los Andes Chili. His wavelength is about 86 metres and his note is DC. He was logged a week ago by Mr. Galpin (**5 NF**), whose reception seems to be very efficient and who seems to have been the first European to have received an Australian amateur, though I am not sure that his reception has been confirmed.

Mr. J. C. Braggio, who is at present in Birmingham, informs us that his father is transmitting every morning at 0430/0530 G.M.T. and listens for European amateurs from 0530; his wavelength is 120 metres.

I am extremely grateful to members of the T. & R. Section for their generous support in the way of reports, as in the last fortnight I have received the large total of **FOUR**.

I will conclude this week with that true old proverb:

"ACTIONS SPEAK LOUDER THAN WORDS."

GERALD MARCUSE,
Hon. Sec., Transmitter and Relay Section.

CHANGE OF ADDRESS.

Mr. T. W. Higgs (**5 KO**), late of Bristol, informs us that after November 21st his address will be "Park Side," 24 Leazes Terrace, Newcastle-on-Tyne. He hopes to resume transmissions very shortly.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 26th.

Radio Society of Great Britain. Ordinary Meeting. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Wavemeters." By Mr. L. B. Turner, M.A., M.I.E.E.

Royal Society of Arts. Ordinary Meeting. At 8 p.m. At John Street, Adelphi, London, W.C.2. Lecture with Practical Demonstration, "Talking Motion Pictures." By Mr. C. F. Elwell, B.A. (Mr. Alan A. Campbell Swinton, F.R.S., late Chairman of the Council will preside).

Radio Research Society, Peckham. At 44 Talfourd Road. Lectures: "Elimination of Interference," "Characteristic Curves."

Streatham Radio Society. At 35 Streatham High Road. Lecture: "Transmission," By Mr. L. E. Owen (**2 VS**).

Bristol and District Radio Society. At 8 p.m. Wireless Lecture No 5. By Mr. W. A. Andrews, B.Sc.

Edinburgh and District Radio Society. At 8 p.m. At 1.7 George Street. Lecture: "The Automatic Telephone." By Mr. J. Plucknett, A.M.I.E.E.

THURSDAY, NOVEMBER 27th.

Luton Wireless Society. At 8 p.m. At Hitchin Road Boys' School. Experiments and Demonstrations for Beginners.

Walthamstow Amateur Radio Society. Lecture by Mr. J. F. Stanley, B.Sc., A.C.G.I.

West London Wireless and Experimental Association. Question Night.

FRIDAY, NOVEMBER 28th.

Bristol and District Radio Society. Demonstration and Address by Metro-Vick Supplies, Ltd.

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BROADCASTING.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:

GREAT BRITAIN.

CHELMSFORD 5 XX, 1,600 metres, Tests. **ABERDEEN 2 BD,** 495 metres; **BIRMINGHAM 5 IT,** 475 metres; **BELFAST 2 BE,** 435 metres; **GLASGOW 5 SC,** 420 metres; **NEWCASTLE 5 NO,** 400 metres; **BOURNEMOUTH 6 BM,** 385 metres **MANCHESTER 2 ZY,** 375 metres; **LONDON 2 LO,** 365 metres; **CARDIFF 5 WA,** 351 metres; **RELAY STATIONS**: **LEEDS-BRADFORD 2 LS,** 346 and 310 metres; **PLYMOUTW 5 PY,** 335 metres; **DUNDEE 2 DE,** 331 metres; **EDINBURGH 2 EH,** 328 metres; **NOTTINGHAM 5 NG,** 322 metres; **HULL 6 KH,** 335 metres; **LIVERPOOL 6 LV,** 315 metres; **SHEFFIELD 6 FL,** 301 metres. Tuesdays, Thursdays and Fridays, 1.0 p.m. to 2.0 p.m. (**2 LO** only). Regular daily programmes, 3.0 to 7.30 p.m., 8.0 to 11.30 p.m. Sundays, 3.0 to 5.0 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS ("**Radio Paris**"), **SFR,** 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.30 p.m., Exchange Prices; 4.30 p.m., Financial Report; 5.0 p.m., Concert; 8.30 p.m., News and Concert.

PARIS (**Ecole Superieure des Poste et Telegraphes**), 458 metres. 3.45 p.m. (Wednesday), Talk on History; 8.0 p.m. (Tuesday) English Lesson; 8.30 p.m., Concert; 9.0 p.m., Relayed Concert or Play.

PARIS (**Station du Petit Parisien**), 346 metres; 8.30 p.m., Tests.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 2.0 p.m. and 6.50 p.m., Meteorological Forecast.

BRUSSELS ("Radio-Belgique"), 265 metres. Weekdays, 5.0 p.m. to 6.0 p.m., and 8.0 p.m. to 10.0 p.m.; Sunday, 5.0 p.m. to 6.0 p.m., and 8.30 p.m. to 10.0 p.m.

HOLLAND.

THE HAGUE, PCGG, 1,070 metres. 4.0 to 6.0 p.m. (Sunday), 9.40 to 11.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (**Heussen Laboratory**), **PCUU,** 1,050 metres. 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9.0 p.m. (Thursday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (**Middelraad**), **PCMM,** 1,050 metres, Saturday, 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular), 8.40 to 10.10 p.m., Concert.

AMSTERDAM (**Vas Diaz**), **PCFF,** 2,000 metres, 9.0 a.m. and 5.0 p.m., Share Market Report, Exchange Rates and News.

DENMARK

LYNGBY, OXE, 2,400 metres. 8.30 to 9.45 p.m. (Weekdays), 8.0 to 9.0 (Sunday), Concert

SWEDEN.

STOCKHOLM (**Telegrafverket**), 440 metres Daily 12.45 to 1.0 p.m., Weather Report and Nauen Time Signal; Monday, Wednesday and Saturday, 8.0 to 9.0 p.m., Concert and News; Sunday, 11.0 a.m. to 12.30 p.m., Divine Service from St. James' Church.

STOCKHOLM (**Radiobolaget**), 470 metres. Tuesday and Thursday, 8.0 to 9.30 p.m., Concert and, News.

BODEN, 2,800 metres. Tuesday and Friday, 6.30 to 7.30 p.m., Sunday, 5.30 to 6.30 p.m., Concert and News.

GERMANY.

BERLIN (**Koenigswusterhausen**), **LP,** 680 metres. Sunday, 10.50 to 11.50 a.m., Concert; 2,800 metres, Sunday, 11.50 a.m. to 12.50 p.m., Concert.

EBERSWALDE, 2,930 metres. Daily, 1.0 to 2.0 p.m., Address and Concert; 6.0 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (**Vox Haus**), 430 metres. 11.0 a.m., Stock Exchange; 1.55 p.m., Time Signals; 5.40 to 7.0 p.m., Concert; 7.0 to 8.0 p.m. (Sunday), Concert.

BRESLAU, 415 metres.

HAMBURG, 387 metres.

SPAIN.

MADRID, PTT, 400 to 700 metres. 6.0 to 8.0 p.m., Tests.

MADRID (**Radio Iberica**), 392 metres. Daily (except Thursdays and Sundays), 7.0 to 9.0 p.m. Thursdays and Sundays, 10.0 to 12.0 p.m., Concerts.

MADRID, 1,800 metres. Irregular.

CARTAGENA, EBX, 1,200 metres, 12.0 to 12.30 p.m., 5.0 to 5.30 p.m., Lectures and Concerts.

PORTUGAL.

LISBON (**Aero Lisboa**), 370 to 400 metres. Wednesdays and Fridays, 9.30 to 12.0 p.m., Irregular Tests.

SWITZERLAND.

GENEVA, HB 1, 1,100 metres. Weekdays, 3.15 and 8.0 p.m., Concert or Lecture.

LAUSANNE, HB 2, 850 metres. Daily, 9.15 p.m., Concert and Address.

ZURICH, HBZ, 650 metres. 1.0 p.m., News and Weather Forecast; 8.15 p.m. to 10.15 p.m., Concert.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 12.0 a.m. 1,800 metres, 4.0 p.m. and 8.30 p.m., Tests, Gramophone Records.

ROME, 422 metres. Weekdays 7.30 to 9.30 p.m.,

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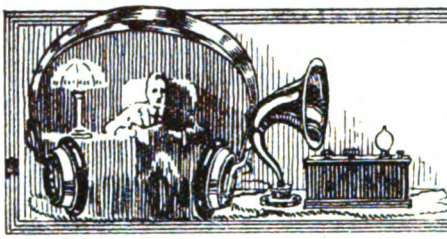

AMONG THE SOCIETIES.

A lecture of unusual interest, on the subject of "Wireless Component Parts," was given before the Ilford and District Radio Society by Mr. Welch on October 28th.

Practically every accessory used in wireless construction was dealt with, from the lead-in tube to the telephones and loud speakers, and the explanations were greatly assisted by suitable slides.

Similar lectures are to be given on the second and fourth Tuesday of each month.

* * * *

"How to Learn Morse" and "Faults in Dual Circuits" were the subjects of two instructive lectures delivered by Mr. Knight, A.M.I.R.E., at a meeting of the Beckenham and District Radio Society on October 23rd. Amateurs in the district desirous of learning Morse are invited to join the Society's Morse class.

* * * *

A lantern lecture on "High Frequency Devices" was given before the Brockley and District Radio Society by Mr. J. Goss (of the Igranic Electric Co), on Friday, October 31st. A simplified explanation was given of various methods of aerial tuning, making use of Igranic coils, and much interest was aroused by the description of the Igranic H.F. devices and the machines employed for winding them.

* * * *

The scientific work of Clerk Maxwell formed the subject of an illuminating lecture delivered by Prof. W. Wilson at a meeting of the Clapham Park Wireless and Scientific Society on Wednesday, October 22nd. The lecture served to show the influence of Maxwell's work on modern electrical theories and its bearing on wireless telegraphy and telephony.

On the following Wednesday an excellent account of the manufacture and properties of ebonite was given by Messrs. McWilliam and Shirley, of the British Ebonite Company.

Realising the value of developing the social side of club work, the Wimbledon Radio Society held a whist drive and dance on Saturday, November 15th, at the Welcome Hall, High Street, Wimbledon. A feature of the evening was the reception of the Savoy Bands dance music from 10 to 11.45 p.m.

Some interesting experiments with portable transmitting and receiving apparatus were carried out by a party of members on the journey to Banstead on Sunday, October 19th. The transmissions were successfully heard by **5 KS** at Southfields.

* * * *

An instructive paper on the design and layout of panels was read by Mr. J. Bulman at a recent meeting of the Borough of Tynemouth Radio and Scientific Society. Much additional information was given after the paper had been read, questions being answered and illustrated on the blackboard.

Mr. Ralph Slade (**Z 4 AG**) *the New Zealand amateur whose signals were first heard in this country by* **G 2 OD**.

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READERS PROBLEMS

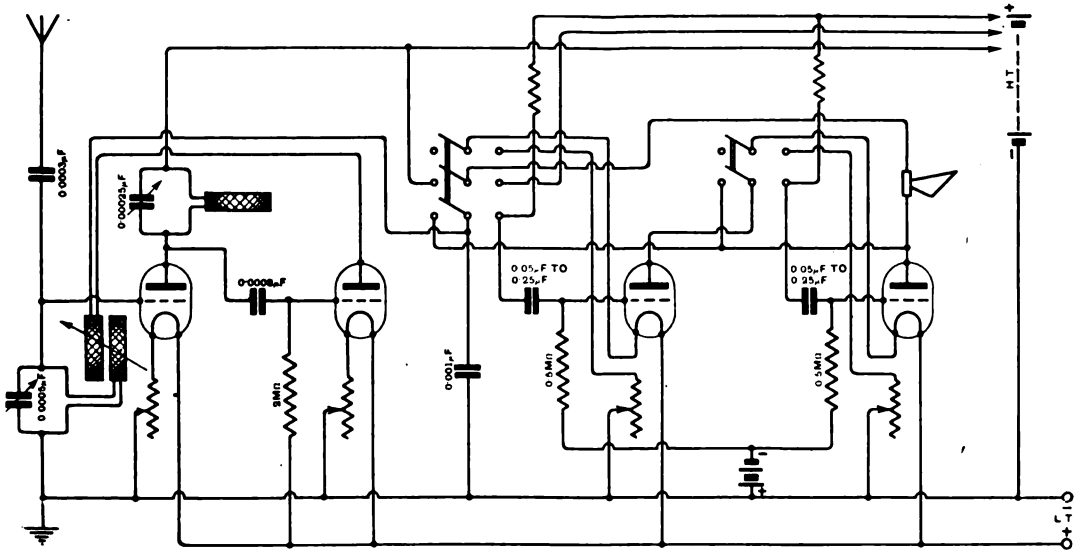
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

A SIMPLE FOUR-VALVE RECEIVER.

A DIAGRAM is given below of a four-valve receiver suitable for the reception of wireless telephony, either with telephones or a loud speaker. One stage of H.F. amplification and two stages of resistance capacity coupled L.F. amplification are used.

Separate H.T. tappings are provided for the H.F., detector, and low frequency valves, as the H.T. voltage for the latter valves will have to be increased on account of the method of coupling employed.

reduced, and the arrangement will suffer from one of the defects of transformer coupling. It would be much better to employ grid coupling condensers having values between 0·05 and 0·25 μF in conjunction with grid leaks of 0·5 megohms, even though this combination gave less signal strength. The use of resistance-capacity coupling is not justified unless the circuit is arranged to give an absolute minimum of distortion. If a slight amount of distortion is to be tolerated, then it would be better to employ transformer coupling, with a consequent reduction in H.T. voltage, and in the number of valves used.



A four-valve receiver of simple and inexpensive construction.

COUPLING CONDENSERS FOR L.F. AMPLIFICATION.

A CORRESPONDENT writes to say that he obtains greater signal strength when using coupling condensers of 0·006 μF in conjunction with 2 megohm grid leaks, than with the values usually specified for these components. With small coupling condensers, however, the amplification of the lower frequencies will be considerably

CHOKE COILS FOR SMOOTHING CIRCUITS.

SEVERAL circuits have been described recently for the purpose of smoothing out the commutator hum when the H.T. current is derived from the D.C. mains. A reader has noticed that in nearly every instance Fullerphone choke coils have been specified, and asks if there is any particular feature in these coils which makes their use desirable in such circuits.

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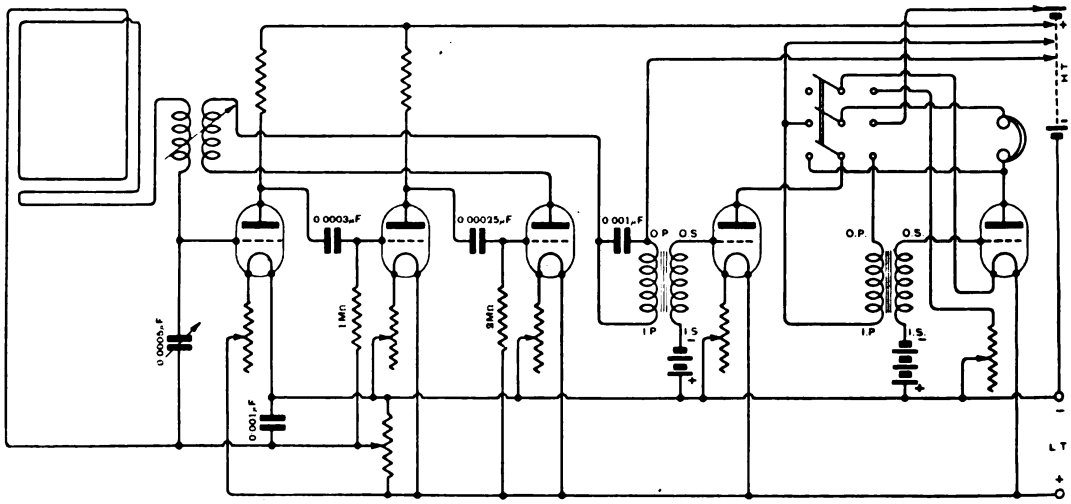
It is not essential to use this type of coil, and it is conceivable that under certain conditions a choke of this type would be too small. The size of choke will depend upon the magnitude of the ripple superimposed on the direct current, and this will depend, amongst other things, upon the type of machinery and the condition of the commutators at the generating station. The secondary windings of intervalve transformers in which the primary windings have been burnt out, make excellent choke coils, as also do the secondary windings of spark coils. The latter type of coil has the advantage that the layers are separated with waxed paper insulation, and are capable of withstanding the high voltages induced when the current is suddenly switched off.

A Frame Aerial Receiver for Long Wavelengths.

THE diagram given below shows the method of connecting a five-valve receiver for use in conjunction with a frame aerial. The receiver will be suitable for wavelengths above 1,000 metres, and the use of resistance coupling for the H.F. valves will greatly simplify the tuning operations. A switch is provided to cut the last valve out of circuit when not required.



A frame aerial receiver for long wavelengths.

The Super-Sensitive Set.

A HIGH frequency transformer suitable for the reception of the high power broadcasting station on 1,600 metres for use in the above-mentioned set may be constructed in the following manner.

The secondary winding should consist of two basket coils, each wound with 125 turns of No. 32 D.S.C. wire. The coils should be mounted together on the same axis, with the windings connected in series in the same magnetic sense. The primary winding should consist of a basket coil of 100 turns of the same gauge of wire, and should be mounted between the two sections of the secondary winding. The tuned condenser will be connected across the ends of the secondary winding, and the connection for the balancing condenser will be taken from the junction between the two halves of this winding. When the transformer is connected in the receiver the connections of the primary winding should be reversed to find the best method of connection.

Fixed Filament Resistances.

IN making up a receiver with a minimum number of adjustments, a reader wishes to incorporate fixed filament resistances for the valves, and asks what values of resistances would be necessary for D.E. 3, D.E. 5, and D.E. 5B. valves respectively when a 6-volt accumulator is used. For a normal filament current, the D.E. 5 will require an external resistance of 54 ohms, the D.E. 5, 4 ohms, and the D.E. 5B., 2·25 ohms.

It will be observed that the difference of potential across the ends of these resistances, when the normal filament current is flowing through them, is equal to the amount by which the normal filament voltages differ from 6 volts. In other words, the external resistances may be regarded as reducing the voltage of the accumulator to the normal voltage required by each valve.

Eureka resistance wire between No. 28 and No. 36 gauge may be used, the thicker wire being used for the D.E. 5 and D.E. 5B. valves, and the thin wire for the D.E. 3 valve.

The following particulars may be of use in calculating the length of wire required :—

S.W.G.	Ohms. per yard.
28	3·90
30	5·57
32	7·35
34	10·13
36	14·04

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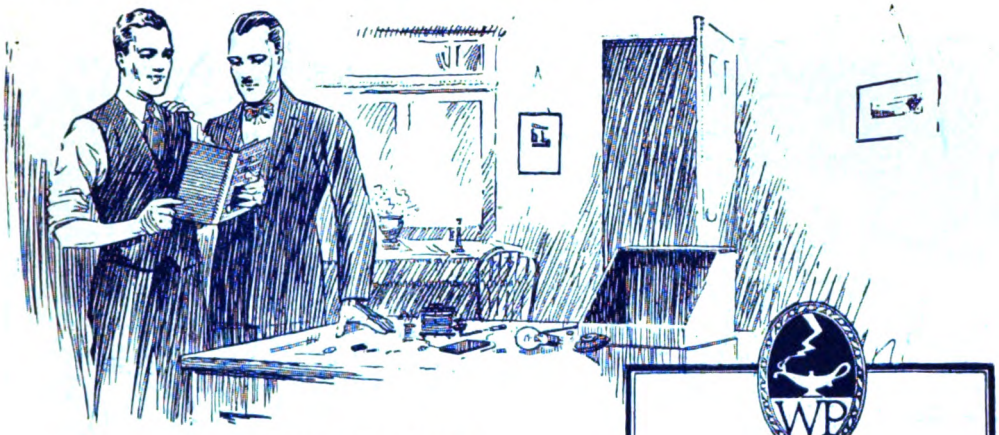

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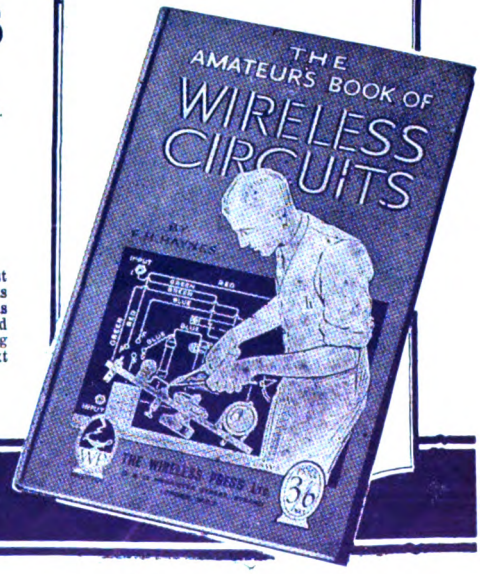
Copious notes on Crystal Receivers, single-valve sets, high frequency, low frequency and dual amplifiers, transmitting circuits. Several pages of most useful data have been added, including the method of pile windings, tables giving tuning range of commercial types of inductances, wavelengths produced by various tuning condensers, types of receiving valves and their characteristics, etc., etc.



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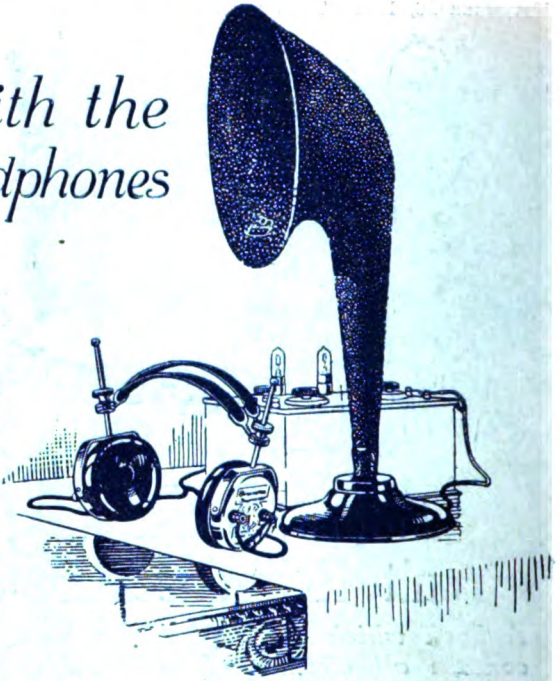

All Brandes products carry our official money-back guarantee, enabling you to return them within 10 days if dissatisfied. This practically constitutes a free trial.

The *Table-Talker* is a Brandes quality product at a moderate price. The non-resonant, specially constructed horn is matched to the unit so that the air resistance produced will exactly balance the mechanical power of the diaphragm. This means beautiful sound-balance and remarkable tone qualities. It is twenty-one inches high, has a self-adjusting diaphragm and is finished a shade of neutral brown .. **42/-**

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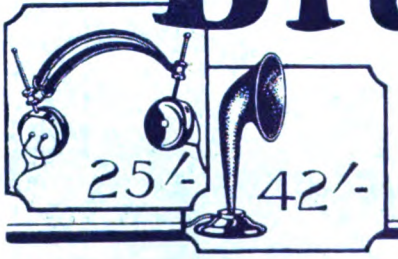

The name to know in Radio

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THE WIRELESS WORLD AND RADIO REVIEW

PRICE 4D NET.

DEC 29 1924

AN IDEAL THREE VALVE RECEIVER

INTERNATIONAL RADIO WEEK

No. 277 [No. 10 Vol. XV]

BUILDING A SINGLE VALVE SET

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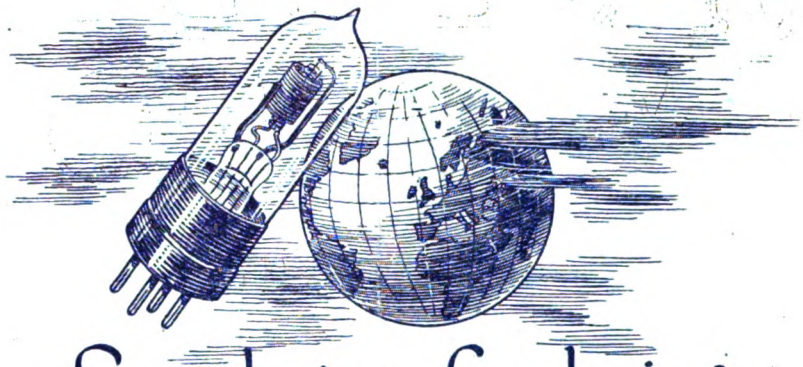

Learn the joys of exploring.

IT may be that you are one of the people who are content with a "crystal." You get entertainment direct from your local station. It is "good enough." But *is* it? Only the man with the valve realises the fascination of exploring. Out in the ether are wandering music and voices—they are coming from every corner of the broadcasting world. Your aerial is picking them up, but you cannot hear them. That valve would lend a new meaning to your "listening in." It gives to a wireless set all the romance of a big adventure.

Ediswan Valves give uniform and excellent results in conjunction with an "all stations" set. They are noiseless in use and combine a high degree of sensitivity with a length of life which makes them very economical in service.

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The first valve ever made was produced in the Ediswan laboratory

EDISWAN VALVES

An interesting study of early wireless history may be made at the Science Museum, South Kensington, London, where the complete series of Dr. Fleming's experimental valves can be inspected.

162-9

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

INTERNATIONAL RADIO WEEK.

By The Editor.

At the time of writing the degree of success attained in reception across the Atlantic of the American and European broadcast transmissions is not known, but yet the tests provide an opportunity to reflect on the future possibilities of international broadcast programmes.

One fact still remains abundantly clear and that is that however successful reception may be on any one occasion, it is impossible to depend upon results to any pre-arranged schedule since the causes which contribute to "good" and "bad" reception periods are not yet understood and certainly cannot be foretold.

Because it is frequently possible to receive direct across the Atlantic intelligent, though imperfect, speech and music in all parts of the country, and especially in view of the success which has attended the recent demonstrations of re-broadcasting of American transmissions by the B.B.C. here, one is justified in having an optimistic outlook upon the future, and in believing that, in principle, at all events, the ambitious programme of the present international tests foreshadows the very definite achievements which the future holds in store.

The need at the present stage of development of long distance wireless telephony is for more data upon which to work, and from which assumptions may be deduced. Then step by step the accuracy of these assumptions can be checked by practical work, but the first requirement is certainly reliable data collected from observations on reception under varying conditions. Dependable wireless telephony communication over such great distances must not be looked forward to as an achievement to be realised at an early date, because everything points to the fact that many obstacles have yet to be surmounted before such a goal can be reached.

Even when all other considerations have been met, and the technical efficiency of both the transmitting and receiving equipment has been perfected, the problem of atmospheric interference is still likely to prove the greatest stumbling block as it still is in all long distance communication. Perhaps the utilisation of very short wavelengths, which present observations indicate are comparatively free from atmospheric trouble, may be the solution, but here again progress is likely to be proportional to the amount of data which can be collected from a multitude of observations. The amateur is in a position to provide a large percentage of data such as is likely to be of value, and perhaps reports of reception in connection with these international tests may contribute towards supplying much information which will ultimately assist in the solving of outstanding problems. It is only by organised effort such as this that sufficient data can be collected to provide information of value after it has been sifted and examined.

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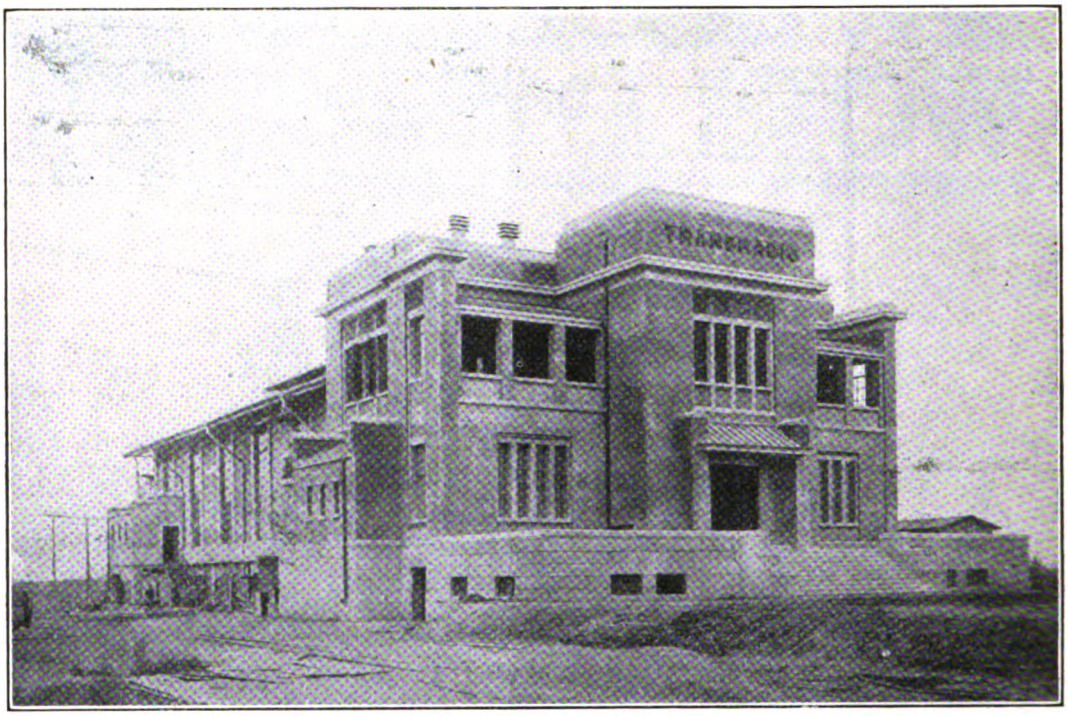

Fig. 1. *A photograph of the station building taken shortly before its completion.*

"LPZ" — THE HIGH POWER STATION AT BUENOS AIRES.

(By A SPECIAL CORRESPONDENT.)

ANOTHER of the world's giant wireless stations has reached completion at Monte Grande, near Buenos Aires, in the Argentine. This station has not been built entirely by one commercial wireless company, but is the outcome of the efforts of several companies which have combined in the production of Argentine's largest wireless installation.

The station is erected for communication not only with the continents of both North and South America, but, in addition, conducts traffic and maintains communication between the Argentine and nearly all other countries of the world. The fact that the station has been designed and erected by a combination of the greatest wireless companies in the world facilitates this object, because, in planning the station, consideration was given to the fact that it was destined to communicate with other stations belonging to various companies, or installed by them, all over the world.

The transmitting station is erected on a site some 12 miles from the City of Buenos Aires, whilst the receiving equipment is located at Villa Elisa, some 30 miles from the city. The aerial at the transmitting station is directional north-west to south-west—that is to say, directional to Europe—and it consists of two halves forming a giant T supported by ten high masts of approximately 680 ft. each. Each half of the T aerial is composed of 16 wires about 1,270 metres

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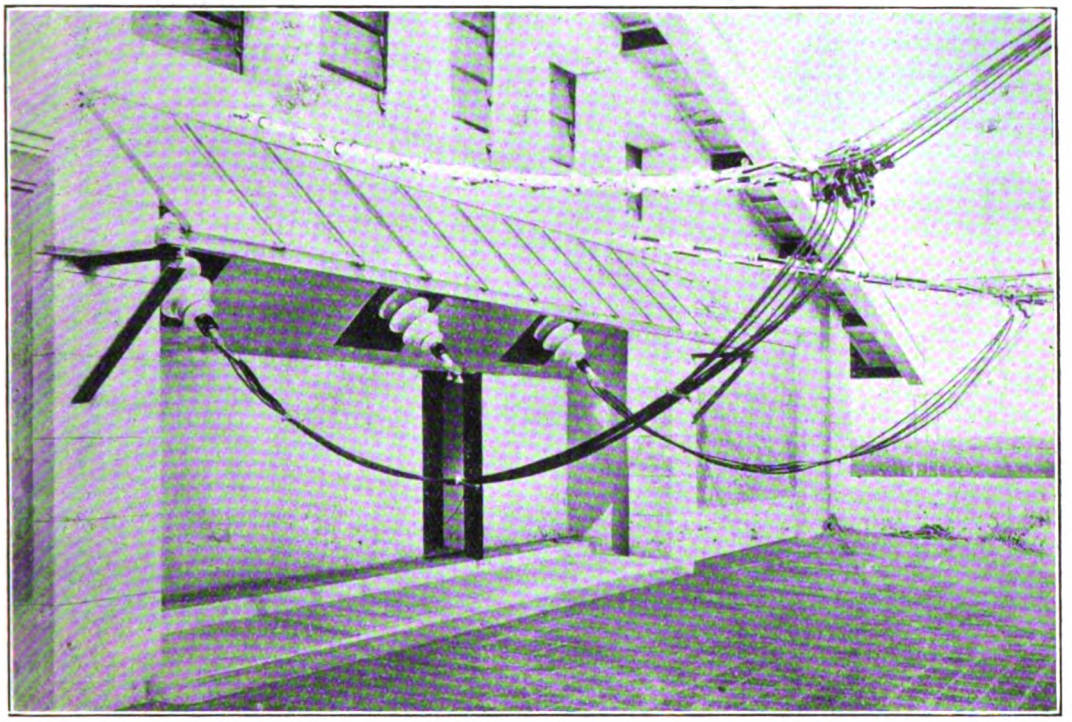

Fig. 2. Aerial lead-in to the transmitter building, showing the method of support.

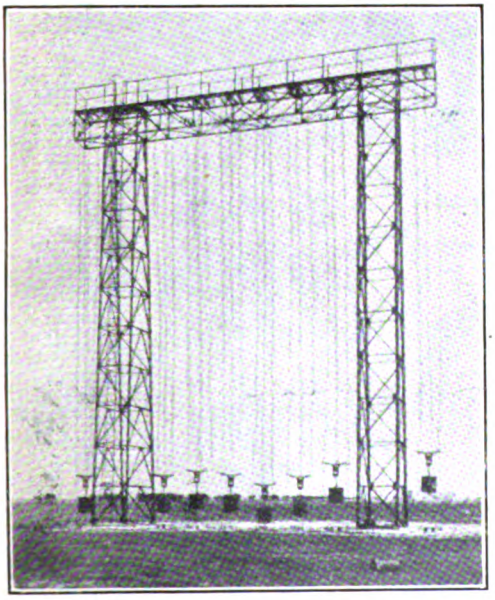

Fig. 3. Counter-weights to maintain the requisite tension on the aerial wires.

in length. Six of the masts are built by the Telefunken Company, and the remaining four by the French company, C.T.S.F. The aerial is supported in some 200 places, and 1,000 insulators are used for this purpose. The masts which support the aerial wires are in pairs, with supports of steel cables run between them. These supports carry the aerial wires, which are on insulated rollers, and at either end of the aerial the wires are weighted as shown in the photograph, Fig. 3. these weights being 40 kg. each, and serving to maintain the requisite tension and to compensate for any variation in the length of the aerial wires due to differences of temperature. It is perhaps difficult when one is in the habit of thinking of aerial wires of, say, 100 ft. in length, to realise the enormous strain which can result from expansion or contraction of the wires constituting the aerial system of one of the high power stations.

By employment of the compensating weight, these differences in length due to variations in temperature are self-adjusting

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without exercising any additional strain either on the aerial wires themselves or on the supporting masts.

The earthing arrangement consists of a buried network, and in addition, overground wires supported at a height of 10 metres from the ground. Fig. 1 shows the appearance of the main building, which is of an architecture similar to that adopted by most of the designers of modern high power stations. The central power station at Buenos Aires provides the electrical power for operating the station. On arrival at the station the supply is transformed down from 12,500 volts to 3,200 volts, and supplies two motors, which drive the dynamo and other machinery utilised in the equipment of the station.

Two high frequency machines are installed, one being employed for transmission whilst the other is in reserve. The high frequency generator gives an output of 1,000 amperes, 750 volts at a frequency of 6,000. Fig. 2 shows the method employed for leading in the aerial wires to the transmitting room. Fig. 4 gives an indication of the method of supporting the aerial lead-in as it is brought to the station in order that all strain should be removed from the actual leads as they

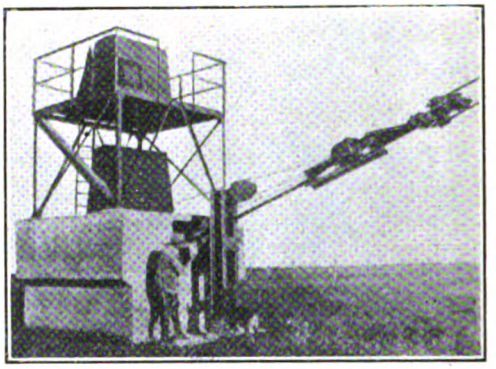

Fig. 4. Anchorage for the aerial lead-in.

enter the building. Fig. 5 is a view taken inside the transmitting building. Fig. 6 shows the interior view of the receiving station at Villa Elisa.

The station which is now conducting

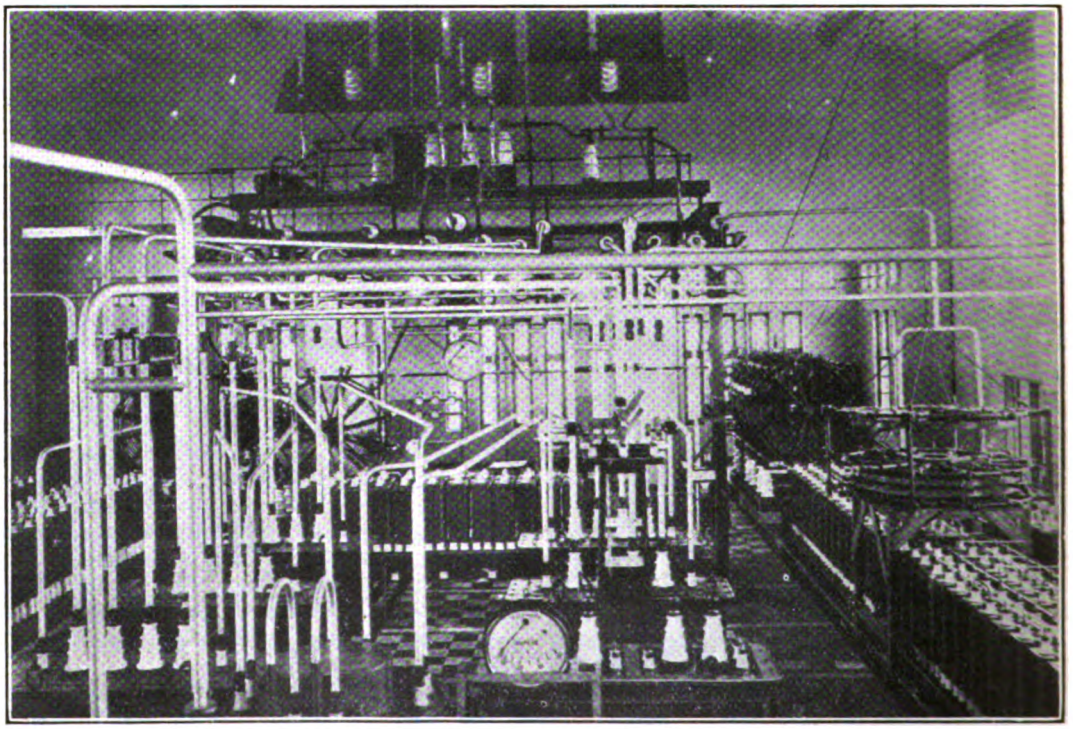

Fig. 5. Interior of the station building.

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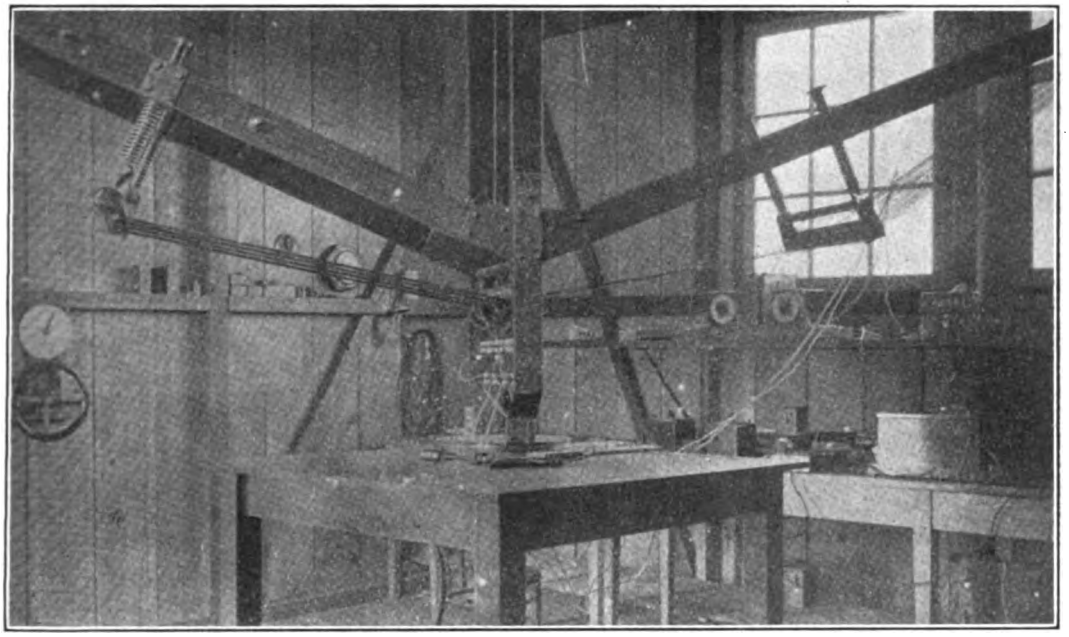


Fig. 6. A corner of the receiving room at Villa Elisa.

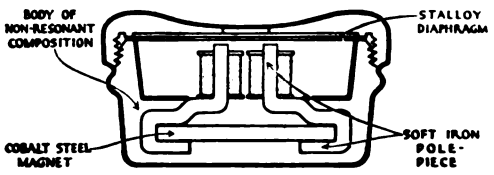
constant traffic with Europe operates on a wavelength of 17,300 metres when communicating with this country, whilst other wavelengths are used for communication with North and South America, the Continent, and other parts of the world.

TELEPHONE RECEIVER MANUFACTURE.

SOME INTERESTING PROCESSES AT THE B.T.H. WORKS.

As the telephone receiver came into being many years ago it would be expected that its design would have become entirely standardised, particularly as it is such a simple instrument composed of so few components. A recent visit to the Coventry works of the British Thomson-Houston Company revealed that the process of evolution is still going on in both the design and manufacturing methods brought about by the present enormous demand.

In brief, manufacture starts with the preparation of a short cobalt steel bar used to provide the polarising field, which is a departure from the more usual form of circular magnet. The adoption of cobalt steel is a new feature, and has been developed for use in the telephone receiver as a result of the extensive experience which the B.T.H. Company possess in the manufacture of permanent magnets for ignition magnetos. Soft iron pole pieces are clamped on to the ends of the bar, making a good magnetic union. The entire case is next moulded around the magnet, thus holding it firmly in position and eliminating any chance of vibration, and at the same time obviating the use of screws. The moulding material, which is a form of Bakelite, has been specially developed to possess good insulating and dielectric properties, and is brown in colour. The remaining manufacturing operations, consisting of winding, setting up, and packing, are carried out mostly by women and girls working in sections or teams, each team producing complete head telephone sets. The finished product is transported by a belt conveyor, and means are provided for automatically indicating and registering the output of each team. The output of the various teams, as the day progresses, is recorded on electrically propelled dials, so that comparisons



A section through the receiver.

can be readily made and a competitive spirit created.

Testing is accomplished by blind workers, trained by St. Dunstans, and these men are found to possess extraordinary powers of aural observation.

While passing through the workshops and laboratories one notices the large scale on which the manufacture of wireless equipment is carried out, and realises the extent to which broadcast reception has been taken up by the public.

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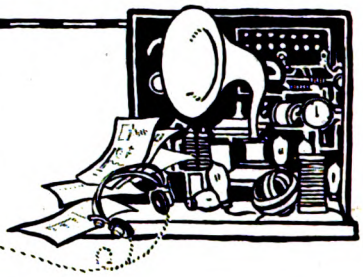
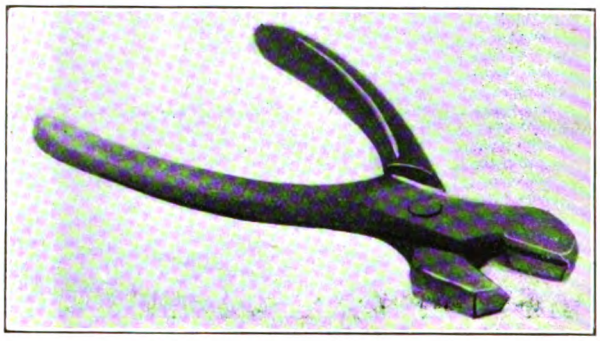
NEW APPLIANCES.



Right Angle Bending Pliers.

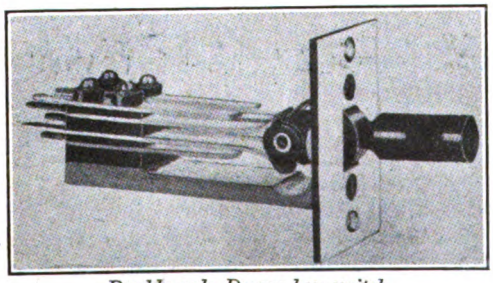
The beginner may find some difficulty in correctly shaping the leads when using No. 16 S.W.G. tinned copper wire for connecting up a receiver. The principal difficulty which arises is that of making the bend at the point where it is precisely needed, for when using ordinary square-nosed pliers the actual bending point takes place a little way from the jaws, depending upon the stiffness of the wire. The pliers shown in the accompanying illustration have V-shaped jaws, and when closed on to the wire, create a bend exactly where required and at a precise right angle. For neat wiring these pliers considerably simplify the operation, giving a neat and workmanlike appearance.



The Aermonic pliers, with grooved jaws for producing right angle bends.

A New Key Switch.

The utility of a receiving set is considerably extended when fitted with switches for changing the circuit arrangement, though every care must be taken to ensure that the introduction of a switching device does not render the receiving set inefficient.



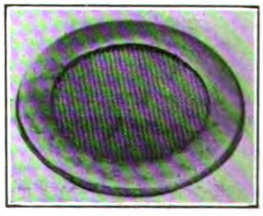
Double-pole Dewar key switch.

Of the many types of switches obtainable, those have the best appearance in which the contacts are behind the panel and are operated by means of a key on the front. The wel-known Dewar type is an excellent example, although not always suitable for use in H.F. circuits. A switch of good clean construction is shown in Fig. 2, and is a product of International Wireless Manufacturers, Limited.

Liberal spacing has been provided between the contact blades and the switch is substantially built. The springs are of German silver tipped with non-oxidising contacts, while the body of the switch is machined all over to give a good clean precision finish.

Valve Window.

The manufacturers of the Aermonic products have added a valve window to their range of components. It is a little larger in diameter than the type usually seen, and is well finished bright nickel with fixing screws. No screw-heads appear on the front rim.



The Aermonic valve window.

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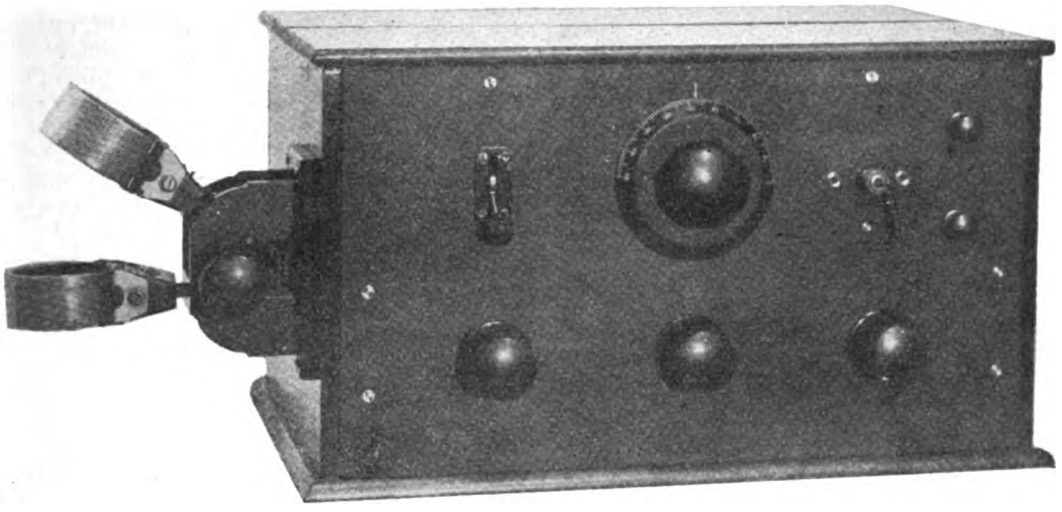

IDEAL RECEIVERS—I.

Under this heading the author will describe a number of receivers. Each instrument is to be built to meet certain requirements. A full discussion of the principles underlying the design and operation of the receiver, and, of course, complete constructional details will be given.

A THREE VALVE RECEIVER

With Valve Detector and Two Stages of Choke-coupled L.F. Amplification.

By W. JAMES.

THIS instrument was designed for the man requiring a receiver (A) with only one tuning control, and, of course, adjustable reaction, (B) giving high quality amplification, and (C) strong loud speaker reproduction from at least the local and high power broadcast stations.*

The receiver is tuned by a variable condenser and a plug-in coil, which are connected in the aerial circuit. The coil is accommodated in one of the plugs of a two-coil holder, and a switch is employed to connect the condenser in series or in parallel with the coil. This switch is employed because it is usually better to have the tuning condenser in series with the coil when receiving short wavelength signals, and to have them in parallel when receiving long wavelength signals.

Now there is a break in the band of wavelengths which may be tuned in with a given coil when the condenser is connected in series and then in parallel. For instance, suppose the aerial acts as a fixed condenser having a capacity of 0·0003 microfarads, and that the tuning condenser has a range of 0·0001 to 0·001 microfarads. When the condenser is in series (Fig. 1A) the effective capacity—which may be found from the formula $\frac{C_1 \times C_2}{C_1 + C_2}$ has a minimum value of 0·000075 μF, and a maximum value of 0·00023 μF. With the tuning condenser in parallel (Fig. 1B) the minimum capacity is 0·0004 μF and the maximum capacity 0·0013 μF. That is, the wavelength range, assuming the coil has an inductance of

* Under normal conditions several other stations can be heard with satisfactory volume.

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100 microhenries, is approximately 163-285 metres when the tuning condenser is in series, and 375-680 metres when in parallel. Therefore wavelengths between 285 and 375 metres cannot be tuned in unless the coil is changed.

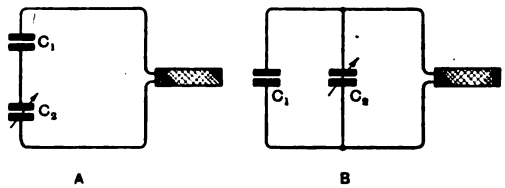

Fig. 1. Explaining the effect of (A) connecting the aerial tuning condenser in series with the aerial and (B) in parallel.

To remove this disadvantage the circuit has been so arranged that when the tuning condenser is switched in parallel with the coil a fixed condenser is connected in series with the aerial to lower the effective capacity of the circuit to a value which is a little less than the maximum capacity of the circuit when the condenser is in series. The connections of the series-parallel switch are given in Fig. 2. It will be seen that when the left-hand contacts are connected, the tuning condenser and coil are in series with the circuit, and when the right-hand contacts are connected the tuning condenser and coil are in parallel, and the aerial is connected to the tuned circuit through the fixed condenser.

A suitable value for the fixed condenser is easily found, for as the minimum capacity is to be a little less than 0·00023 μF, and

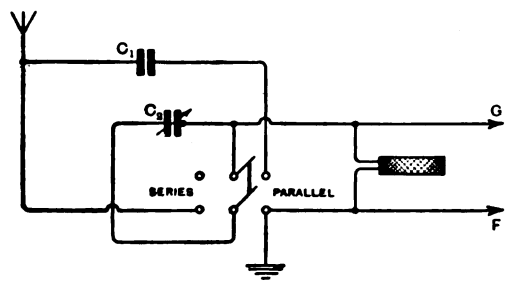

Fig. 2. The special connections of the series-parallel switch and the fixed condenser, C_1.

the minimum capacity of the tuning condenser is 0·0001 μF, the remaining capacity in the circuit should be less than 0·00013 μF. Now we have assumed the aerial to act as a fixed condenser of 0·0003 μF; therefore the fixed condenser may have a value of 0·0002μF —when the resultant capacity is 0·00012 μF. As most aerials have a capacity of rather under 0·0003 μF, a fixed condenser of 0·0002 μF will be satisfactory. The band of wavelengths which may be covered when the tuning condenser is in parallel is now lower, being 280-630 metres.,

It is usual to connect the moving plates of the tuning condenser to earth or to the aerial, and the fixed plates to the grid of the first valve. With the connections of Fig. 2 the fixed plates (indicated by a dot) are permanently connected to the grid, and the moving plates are connected to earth when the condenser is in parallel with the coil, or to aerial when the condenser is in series. The condenser used in the receiver under consideration is a Burndept, maximum capacity 0·001 μF, which has a metal case.

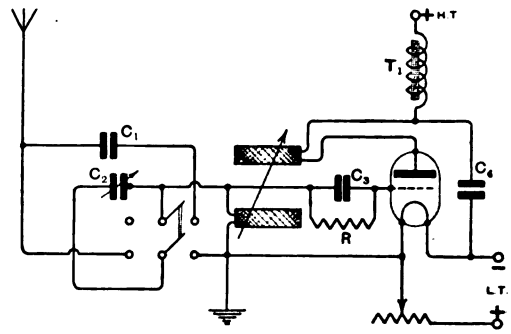

Fig. 3. The aerial circuit connected to the detector.

This case, the metal end plates, and the moving plates, are all at the same potential, and the fixed plates are insulated.

A valve detector is employed in this receiver, and the ends of the tuned circuit are connected to the grid—through the grid condenser and leak, and to the filament (Fig. 3). It will be observed that the grid leak is connected across the grid condenser, the reason for this being that grid condensers are usually provided with clips to accommodate a grid leak, and that it is usually necessary to try several values of grid leak before best results are obtained.

The valve is, of course, a voltage operated device. That is, the effect produced is bigger the larger the voltage applied to the grid. Therefore the grid circuit of the valve is connected across the aerial inductance, and the aerial circuit is so adjusted that the

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largest possible voltages are set up by the signal.

The largest voltages, for a given signal, are usually set up when the tuning condenser has a small value of capacity; consequently the largest coil which will enable the signal to be tuned-in should be employed. When the condenser is in series with the aerial, however, the signal strength may be reduced if the condenser is set at a very low value.

To obtain good selectivity, it is advisable to employ either a small value of capacity in series with the aerial, or a large value of capacity in parallel with the aerial tuning coil

In this receiver a condenser having a maximum value of 0·001μF is employed. It will be found that tuning is critical, particularly when the condenser is set near its minimum value. Tuning is easier when an extension handle is fitted to the condenser.

The advantages of employing a large tuning condenser are that the desired selectivity may be obtained, and a wide range of wavelengths may be tuned in with one coil.

Selectivity and signal strength are considerably improved by reaction. The reaction coil, which is connected in the anode circuit of the detector, is mounted in the movable plug of the two-coil holder (Fig. 3). Fixed condenser C_4 carries the high frequency currents from the top of the reaction coil to the filament of the detector.

THE METHOD OF COUPLING.

There are three types of coupling—transformer, resistance-capacity, and choke-capacity. In this receiver the choke-capacity method of coupling is employed. When transformers are used it is not always possible to obtain high quality amplification, and the disadvantage of the resistance-capacity method of coupling is the high anode voltage required, and the low value of amplification per stage. With choke-capacity coupling, however, it is fairly easy to obtain high-quality amplification, a reasonable degree of amplification per stage, and there is very little waste voltage in the choke.

To ensure good quality with choke-capacity coupling, it is necessary to use a choke having a sufficiently large inductance; to use a coupling condenser of large capacity; and to operate the valves in such a manner that the grids do not become positive during any part of the signal.

From the point of view of signal strength it is necessary to employ chokes having an impedance at the lowest frequency in the signal (say 100 cycles), which is two or three times the impedance of the valve, and to employ valves having a high amplification factor combined with low impedance.

The valve chosen for use in this receiver is the D.E.5 B, which has an amplification factor of 20, and an impedance of 30,000 ohms. From the point of view of quality and signal strength, therefore, the choke connected in the anode circuit should have an impedance of 60,000 to 90,000 ohms, or an inductance of about 100 henries at a frequency of 100 cycles. Chokes having this value are not, so far as I know, readily obtainable; hence, transformers with their windings connected in series are employed in this receiver.

The required inductance may be obtained by the use of a relatively large iron core and few turns of wire, or a large number of turns and a smaller iron core may be employed. It is preferable to use as little iron as possible, provided the self-capacity of the winding and its resistance are kept at reasonably low values. In this receiver Burndept transformers are employed, the windings being connected in series to give the maximum value of inductance.

The total inductance is probably higher than 100 henries. That being so, a signal of 1 volt applied to the grid will set up a voltage of approximately 18 across the choke connected in the anode circuit. This voltage is transmitted to the grid of the next valve by a fixed condenser.

THE COMPLETE CONNECTIONS.

Referring now to the diagram of the complete receiver (Fig. 4), an incoming signal is rectified by the grid condenser and leak C_3 R_1, and appears as magnified voltages across the choke T_1 connected in the anode circuit. These voltages are passed to the grid of the second valve by condenser C_5, which has a capacity of 0·125 microfarads. The grid is held at a suitable negative mean voltage by the grid leak of 0·3 megohms and the grid battery. There will be no appreciable fall in voltage over the coupling condenser, because its reactance to currents of speech frequencies is negligible compared with the effective resistance of the grid leak

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in parallel with the grid filament path of the valve.

As the second valve is being used for voltage amplification, a D.E. 5 B type valve is employed, and a choke T_2 connected in its anode circuit. The magnified voltages set up across choke T_2 are transmitted to the grid of the last valve by condenser C_6, and the grid has connected to it in the usual manner a grid leak and grid battery.

Now the purpose of the last valve is to supply the current to operate the loud speaker. It must be a power valve, that is, a valve having an impedance comparable with that of the loud speaker (or a coupling transformer). As we require *power* to operate the loud speaker the valve must to carry this current, and the loud speaker and a fixed condenser (C_7) are connected in shunt. The choke does not require such a large inductance as those employed in the anode circuits of the other valves because the impedance of the last valve is much lower. The choke used has an inductance of 20 henries, and is a Burndept choke, which is wound with a relatively thick wire. Condenser C_7 has a capacity of 0·5 microfarads.

It will be observed that three grid leaks (each having a value of 100,000 ohms) are connected to the grid side of C_6, and that the grid of the last valve may be connected to points A, B or C. When the grid is connected to point A, the full voltage of choke T_2 is applied to the valve; when it is connected

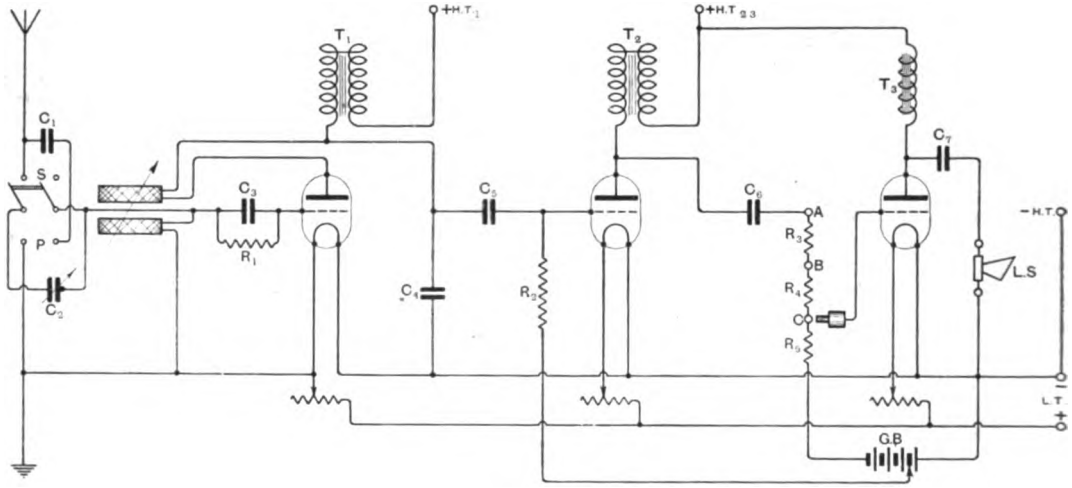

Fig. 4. Connections of the complete receiver.

have ample emission, and because of the low impedance required it will have a fairly low amplification factor. The valve used is a D.E.5, which has an impedance of 7,500 ohms, and an amplification factor of 7.

For good loud speaker results a signal peak voltage of 5, or a total grid voltage swing of 10 volts is required. As the grid of the valve must not be allowed to become positive (to prevent grid current distortion) the grid should have a negative bias of 5 volts, plus, say, 1 volt, to allow for the "free" grid potential and for safety. A grid battery of 6 volts (4 dry cells) is therefore employed.

As the normal anode current of the last valve is of the order of 6 milliamperes a choke (T_3) is connected in the anode circuit

to B or C about two-thirds or one-third of the voltage is applied to the grid.

The reason for the provision of tappings in this way is as follows. We have assumed that the last valve will satisfactorily operate the loud speaker when the signal voltage applied to the grid has a maximum value of about 5 volts. The grid voltage of the second valve is therefore 5/18 volts, and this grid, therefore, has a negative bias of 1½ volts. Strong signals will probably set up ½ to 1 volt across the first choke T_1, and therefore the voltage developed across the second choke T_2 may rise to between 9 and 18 volts. A voltage of this magnitude would overload the last valve, so the tappings mentioned above were provided.

(*To be concluded.*)

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INTERNATIONAL RADIO WEEK.

NOTES ON THE PROGRESS OF THE TESTS.

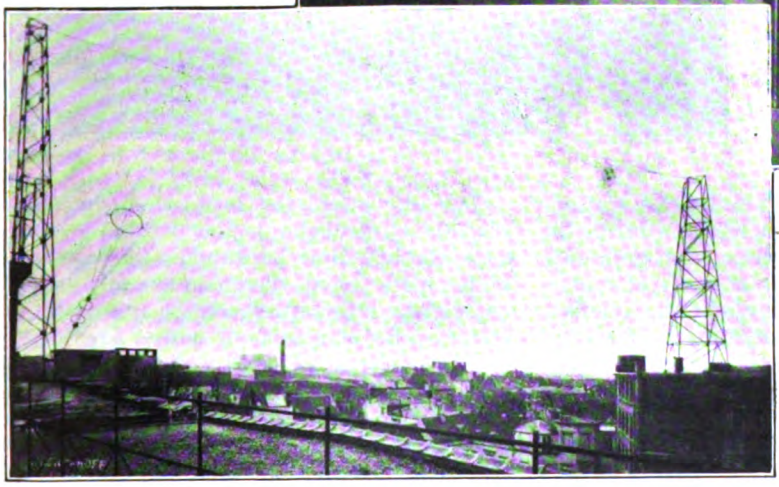
BEFORE any definite statement on the results of the international tests can be published it will be necessary to wait until it has been possible to check reports with the details of the programmes from the various stations.

Programmes transmitted from the European stations are being sent to *Radio Broadcast* in America, whilst *The Wireless World and Radio Review* will be supplied with the programmes of the American stations.

A cable received from *Radio Broadcast* states: "Reception your stations remarkable over entire continent. Thousands of telegrams and telephone calls making reports."

The reports which have so far been received indicate that the reception of Continental stations and the stations of the British Broadcasting Company has been very much more satisfactory than the reception of the American transmissions on this side. This is partly accounted for, no doubt, by the fact that atmospheric conditions here have been unfavourable during the first days of the tests, whilst in addition it must be expected that the number of persons listening to the American pro-

Brussels Broadcasting Station. Views of the transmitting room, and masts and aerial.



This station has been mentioned in the first report from America.

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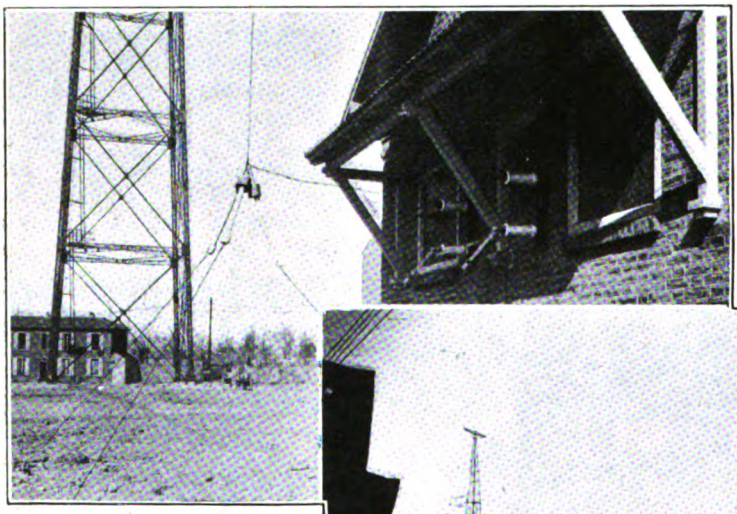
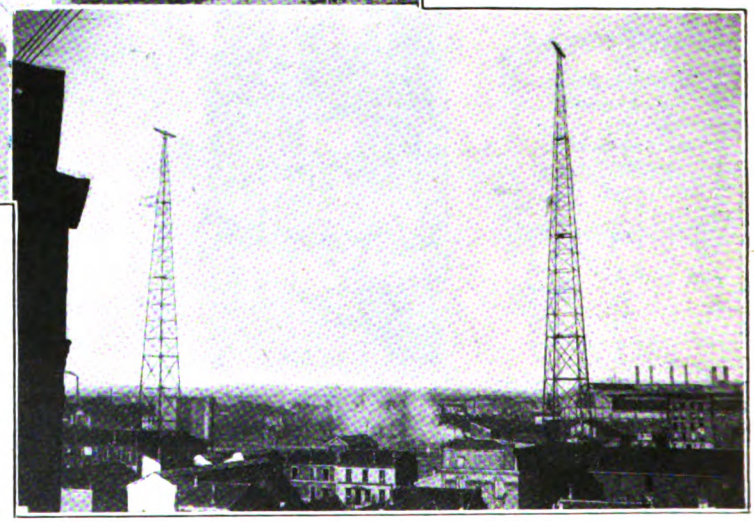
grammes is not so great as would be the case if this occasion were unique for American reception as in America it is unique for the reception of European stations.

Listeners here have much the same opportunity for receiving American stations on any night since they can listen in during the ordinary hours of American programmes. But our normal transmission hours, of course, are made whilst it is daylight in America, and it was therefore imperative that special times for the European transmission should be arranged.

Judging from the early reports received, one of the Continental stations heard best in the United States is the Brussels broadcasting station. The equipment of this station is similar to that at the London station 2 LO and illustrations of the transmitting room and the masts and aerial equipment are given here. Other stations so far reported heard but not yet confirmed, are PTT, Paris, Rome 1RO, and Madrid, whilst early information establishes that several of the B.B.C. stations were identified. How much of the programmes was received in America will be ascertained at a later date.



Radio Paris Broadcasting station.



Views of the masts and aerial and the aerial lead-in to the station building.

The interest in the tests which has been displayed throughout the world is truly remarkable. Both here and on the Continent newspapers have devoted special articles to describing the arrangements and reporting results. By arrangement with *The Wireless World and Radio Review* a representative of *The Times* listened in throughout the test period of the morning of the 27th, and recorded his experiences in the issue of *The Times* for November 28th.

In America the enthusiasm displayed has been even greater, this being accounted for by the reasons referred to above.

When all reports have been received there is no doubt that they will compile a most remarkable record.

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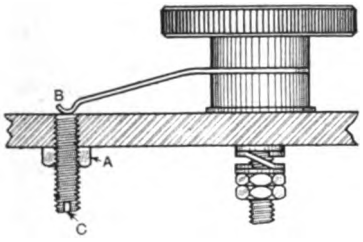
READERS' PRACTICAL IDEAS.

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

H.T. Battery Switch.

WHEN constructing a switch for tapping out the cells of a high tension battery to provide the required critical potential, care must be taken to avoid short-circuiting the studs as the switch arm passes over them.



Switch arm and stud for tapping out the cells of the H.T. battery.

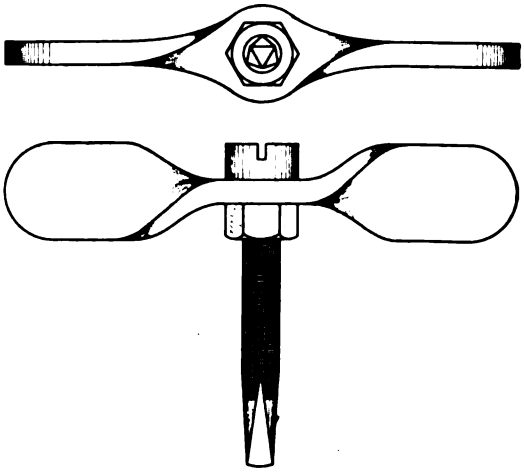
One method is to insert "dead" studs intermediate between those connected to the battery, but a simple arrangement consists in the use of short pieces of threaded 2 BA rod arranged almost flush with the surface of the panel. The diagram explains the construction, and it will be seen that threaded holes are made in the panel and 2 BA screws or short pieces of threaded rod inserted (C). These are locked in position by means of nuts (A), whilst a small indentation (B) arrests the switch arm when exactly over the studs.

W. A. C.

A Useful Tap for Ebonite.

IT is not generally known that a brass threaded spindle is sufficiently hard for tapping ebonite, and, in fact, is often more durable than a steel tap. A useful range of taps can easily be made up by filing a taper on the ends of a screw of the correct size so as to reduce it to three faces, or, alternatively, a bottoming tap may be constructed by filing three V slots down the sides of the thread. A suitable key is made by locking a piece of bent brass under the head of the screw by means of a nut.

G. A. S.



An easily-made brass tap for ebonite.

Switching L.F. Valves.

IT is not often realised that a single pole switch with four contacts can be used for bringing three L.F. amplifiers in circuit as required. The accompanying diagram makes no provision for correcting grid potential with grid cells or for the use of additional plate voltages and shows only the principle for connecting up the low

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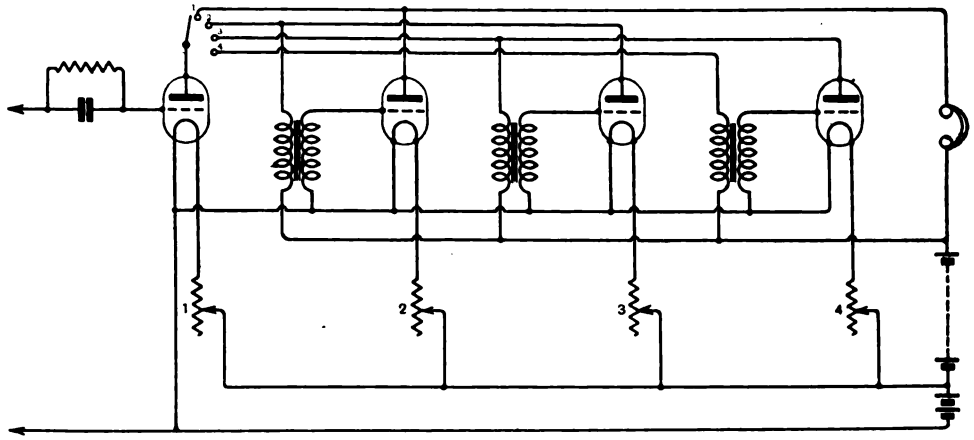
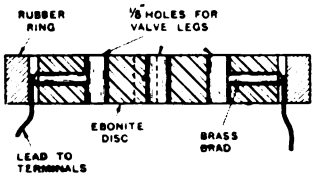


Cutting L.F. valves in and out of circuit by a single arm switch.

frequency amplifying stages. If the circuit is carefully examined it will be seen that the switch effects the necessary circuit changes efficiently and that there are no shunted circuits across the telephone receivers when only one or two of the amplifiers are in use.

With the switch on stud 1, and No. 1 filament rheostat in the "on" position the circuit consists of detector valve only. With the switch on stud 2, and with filament rheostats 1 and 2 on, the circuit is detector and one L.F. amplifier. On stud 3 filament rheostats 1, 2 and 3 should be switched on, giving detector and two L.F. amplifiers. With the switch on the 4th stud and all rheostats on, the circuit is a detector with three L.F. amplifiers.

W. B.

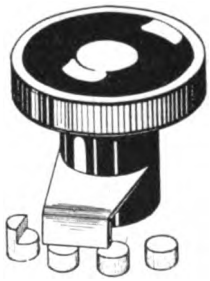


A novel valve holder.

A Simple Low Capacity Valve Holder.

A CIRCULAR piece of ebonite about $\frac{5}{16}$ in. or $\frac{3}{8}$ in. in thickness can be used to construct a useful valve holder. Holes are drilled through in the usual positions for the pins of the valve, while others are drilled in the sides so as to penetrate those already made. Brass brads or rivets are inserted in the side holes, and leads soldered to their heads. If a rubber band is now passed round the outside of the disc the rivets will be driven inwards with a spring action, causing them to make reliable contact on the pins of the valve.

C. O.



Stop for switch arm.

Limiting Switch Arm Movement.

STOP pins are usually employed to prevent a switch arm from passing off the studs, though a much simpler arrangement consists of filing down the studs, leaving raised portions on those at the ends. These raised pieces will engage on the arm and limit its movement, which has the advantage that less panel space is taken up than when pins are fitted.

M. H.

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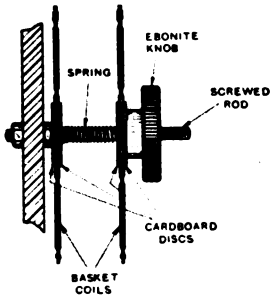
Compact Variable Coupling.

MANY amateurs will find the device shown in the accompanying diagram a most useful component in the construction of receiving apparatus. It can be used as a coupling between aerial and closed circuit,



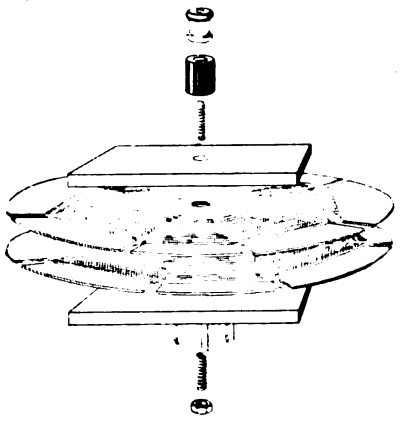
Useful variable coupling for basket coils.

or it can be incorporated when constructing intervalve high frequency transformers. It is quite easy to construct, and the drawing is almost self-explanatory. It will be seen that a screw thread carries two basket coils pressed apart by means of a spring, while a threaded knob is used to vary the distance between them.

R. H. R.

Plug-in H.F. Transformer.

FIXED coil inductances wound upon cards, provide efficient tuning. A pair of these inductances can easily be built up to form an H.F. intervalve transformer in which the coupling between the two coils is fixed. The construction will be seen from the illustration, in which valve pins are tapped into a 3/16 in. piece of ebonite and used to support the two inductances which are spaced apart by a $\frac{1}{8}$ in. ebonite washer, and clamped down by another piece of ebonite held under a screw.

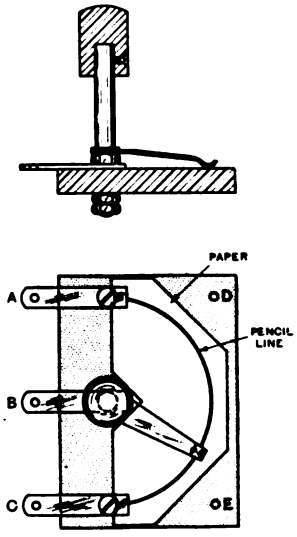


An easily made H.F. transformer.

E. A. A.

Another Variable Grid Leak.

A PENCIL line on good tough paper is well known to be useful as a variable high resistance, though care must be taken as to the method adopted in making a reliable contact. The accompanying sketch shows the paper mounted on the face of a piece of ebonite, the tags A and C being used to make contact with the ends of the pencil.



Variable grid leak.

A spindle and knob is set up with a light bronze spring arm, which is suitably rounded so as not to produce undue wear on the lines or the paper, travelling smoothly over it and picking up reliable connection. The contacts A and C may be made of springy material and slightly bent over at the ends before being attached by the screws. This will cause them to bind down firmly on to the pencilled surface. The holes D and E serve for attaching this variable grid lead to the instrument panel.

A. L. de S.

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PATENTS AND ABSTRACTS

A Method of Generating High Frequency Currents.

An interesting method of producing high frequency currents consists in setting up oscillations by means of a microphone, buzzer or other suitable arrangement, and exciting a circuit tuned to a harmonic of these oscillations. The tuned circuit may be connected to the grid circuit of a valve whose anode circuit is also tuned to the

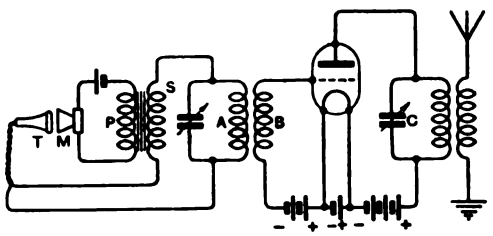

Fig. 1. Explaining a method of generating H.F. currents.

frequency of the oscillations. The invention, which is described in Patent No. 212,563, may be understood by referring to Fig. 1. A microphone, M, is connected to the primary winding of the transformer P, and a telephone receiver T, which is situated in front of the microphone, is connected in the secondary; therefore low frequency oscillations are set up in the secondary circuit. In this circuit is included a circuit A, tuned to a harmonic of the fundamental oscillation.

The inductance of circuit A is coupled to the inductance of circuit B, which is connected to the grid of a valve. Connected to the anode is the usual tuned circuit C which is coupled to an aerial.

Tuning Coils.

Multi-layer tuning coils of the plug-in type are usually wound in such a manner that the finished coil has a low value of self-capacity. There are many types of winding, but they all have spaced turns or layers, and in some of them the turns and layers are spaced. The construction of a new type of coil may be gathered from Fig. 2. A band or tape of paper or other suitable material is formed of a width corresponding to the axial length of the coil desired, with a number of wires arranged parallel to the edges of the tape and secured to the tape by a strip of insulating material. The appearance of the tape may be seen from Fig. 2A, and the section of Fig. 2B. The wires may be spaced a suitable distance, preferably at least equal to their diameter.

The tape is wound into a coil having as many layers as are necessary to give the required inductance. When the coil is

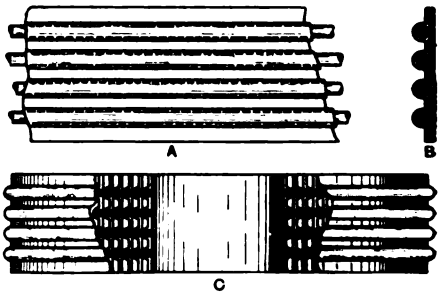

Fig. 2. Construction of a multi-layer coil.

wound the wires at each end of the tape are brought out, and the ends connected to form a continuous winding. Fig. 2C is a sketch of a complete coil. Coils of this type are patented (No. 221,594) by N. P. Hinton and Metropolitan Vickers Electrical Co.

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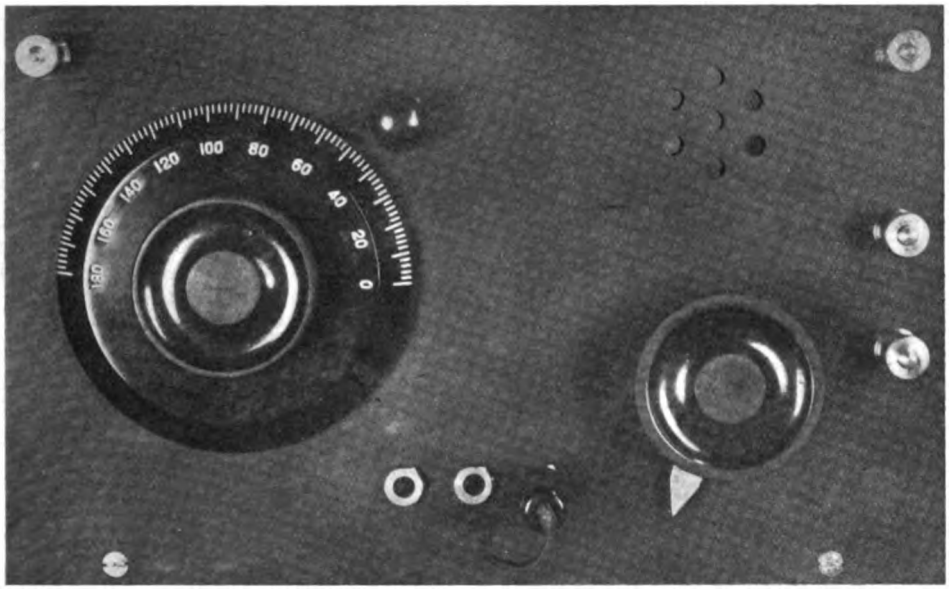

The panel. The terminals at the top are aerial and earth, with telephone terminals on the right. Near the condenser dial is the fine tuning knob. The sockets at the lower edge tap out the tuning coil.

INSTRUCTIONS FOR MAKING A

SINGLE VALVE RECEIVER.

Repeated requests for simple constructional details of a single valve receiver prompted the preparation of this article. The circuit is an old favourite, and no elaborating features have been introduced. The skilled experimenter can recommend this set to his less experienced friend. Constructional details all work out easily, and the merest novice should find no difficulty in carrying the job through while the finished set forms a good starting point in valve reception.

THE first valve circuit the amateur adopts as he progresses is invariably one consisting of a tuned aerial with variable condenser and inductance, detector valve with grid condenser and leak, with reaction coil and telephones connected between the plate and the high tension battery. Although the number of circuits developed for reception purposes is almost unlimited, it can be said that this simple arrangement is very popular for amateur work and is employed in more than half of the varieties of broadcast receiving sets to be found on the market. It has its place also in the experimenter's laboratory, and it is of interest to observe that many of those who achieve distinction by receiving over immense distances confess to its use.

A vertical panel screwed at its lower edge or bracketed to a baseboard is the simplest form of construction for experimental apparatus while producing a set of good appearance. The components requiring adjustment and which usually need to be carefully insulated are attached to the ebonite, whilst the remainder of the fitments are secured by wood screws to the baseboard

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and, as a rule, possess the requisite insulation.

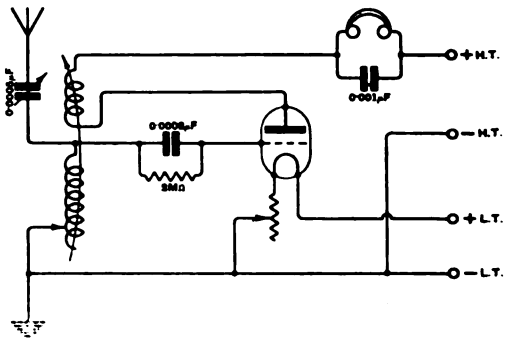
A full size drawing is given of the front panel and the dimensions can be transferred either with the aid of a rule or by pricking through, using the page as a template.

The beginner might be advised that ebonite panels are shaped up first by filing one of the longer edges true as tested by laying a steel rule along it and at right angles to the face by means of a square. The edge may be finally finished by drawing it across a piece of carborundum paper laid flat on the table, applying an even pressure to both ends while the straight line scratches may be removed if desired by still holding the panel quite vertically and employing a rotary motion. The two ends are next squared up to the required length and at right angles to the first edge, while the other long edge is finished by filing down to a scratch line indicating the width of the panel. When filing or sawing ebonite the work should be clamped so as to only just project above the edge of the vice, or, if this is not possible, a piece of hard wood should be placed behind it and extending nearly to the edge under treatment so as to prevent vibration and chattering.

The centre indicating the position of the condenser will be found suitable for almost any type, while an additional hole is shown in the drawing of the panel to accommodate the fine adjustment knob fitted to the "J.B." condenser used in this instance. It has capacity of 0·0005 mfds. If the reader does not possess a drill sufficiently large for making the centre hole it can be produced by enlarging a small hole with the tag of a file or by working to a scribed circle of the required size with a round or rat-tail file. Positions for holes for fixing an Ormond filament resistance are given, whilst the valve is viewed through a grating of seven holes set out by marking off a radius around a circle.

The baseboard is constructed from $\frac{3}{8}$ in. planed mahogany, the long edges being planed to give the correct width and the ends filed down true to lines set out across the face. It should be rubbed down with fine glasspaper and treated on both sides with shellac varnish or quick drying French polish. This treatment closes the pores of the wood and prevents warping. The terminal strip may also be made up from wood which possesses ample insulating properties for the direct current potentials of the H.T. and L.T. batteries.

The tuning inductances are wound on cards of the stiffness of postcard. They can be pricked through from the drawing showing the lay-out of the components on the baseboard, taking care when cutting out not to make the slots so deep as to weaken the sections. Three cards are required and are wound full with No. 26 double cotton-covered wire. To avoid difficulties when connecting up, one should see that the direction of winding is the same on each card. The middle turn on one card is slightly lifted up by levering with the blade of the screwdriver, scraped clean and a spare piece of the



The circuit.

No. 26 wire soldered to it. A small piece of paper, silk ribbon, or empire cloth should be inserted under the joint. This card is laid flat on the baseboard in the position shown and the three wires which pass from it connected to the three Aermonic tapping sockets, the centre lead being connected to the socket on the left as viewed from the front. This centre lead is also joined to the outside end of another coil, and it is most important to examine the two windings to observe that the direction of rotation of the wire as it passes from one inductance to the other is continuous. A piece of paper is inserted between the two inductances, and they can now be screwed down to the baseboard with three small screws, placing thin pieces of cardboard over the centres on the top and underside before putting the screws through.

The other inductance, which is the reaction coil, is arranged to swing by means of a short wooden arm over the two

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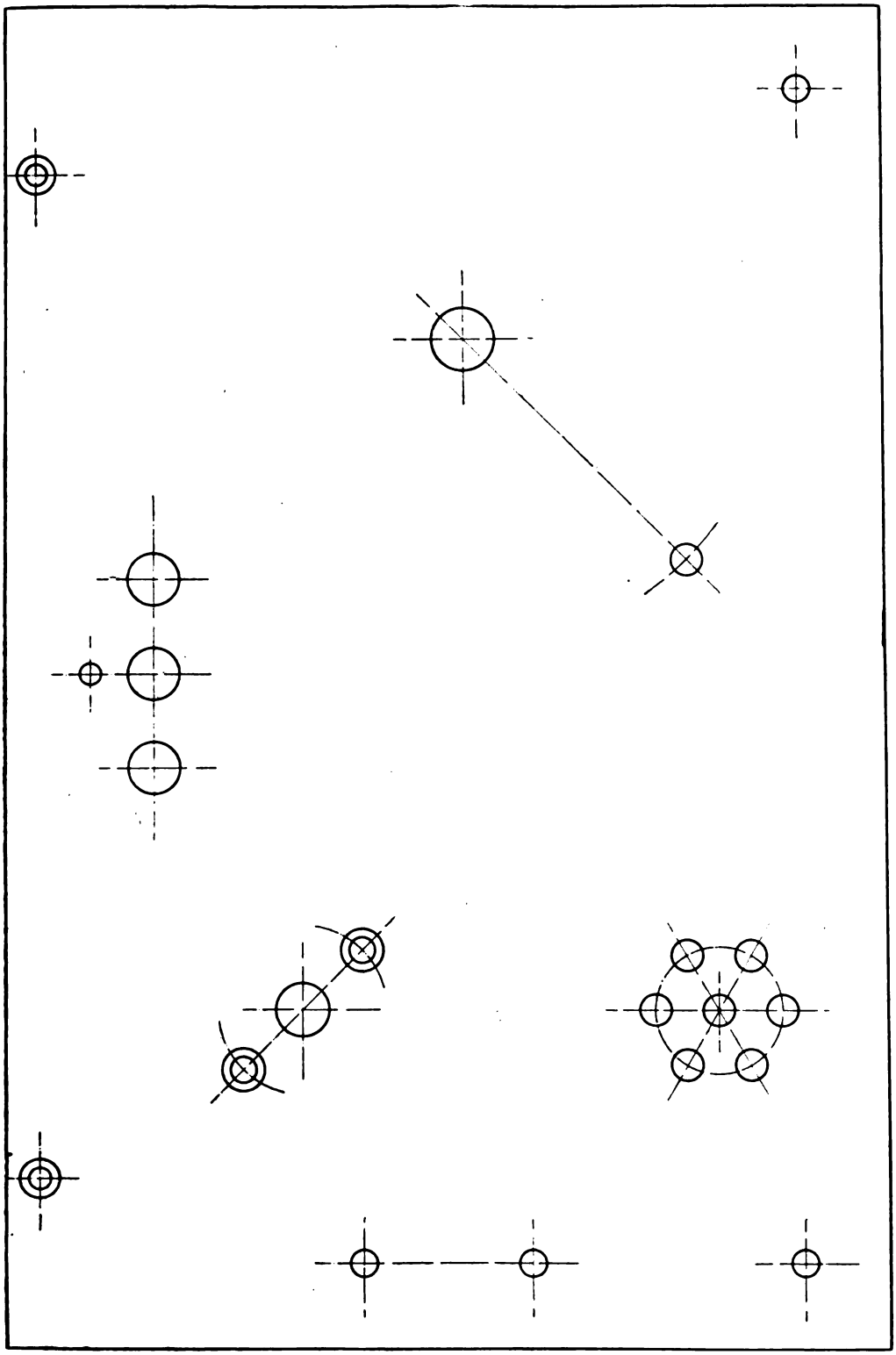

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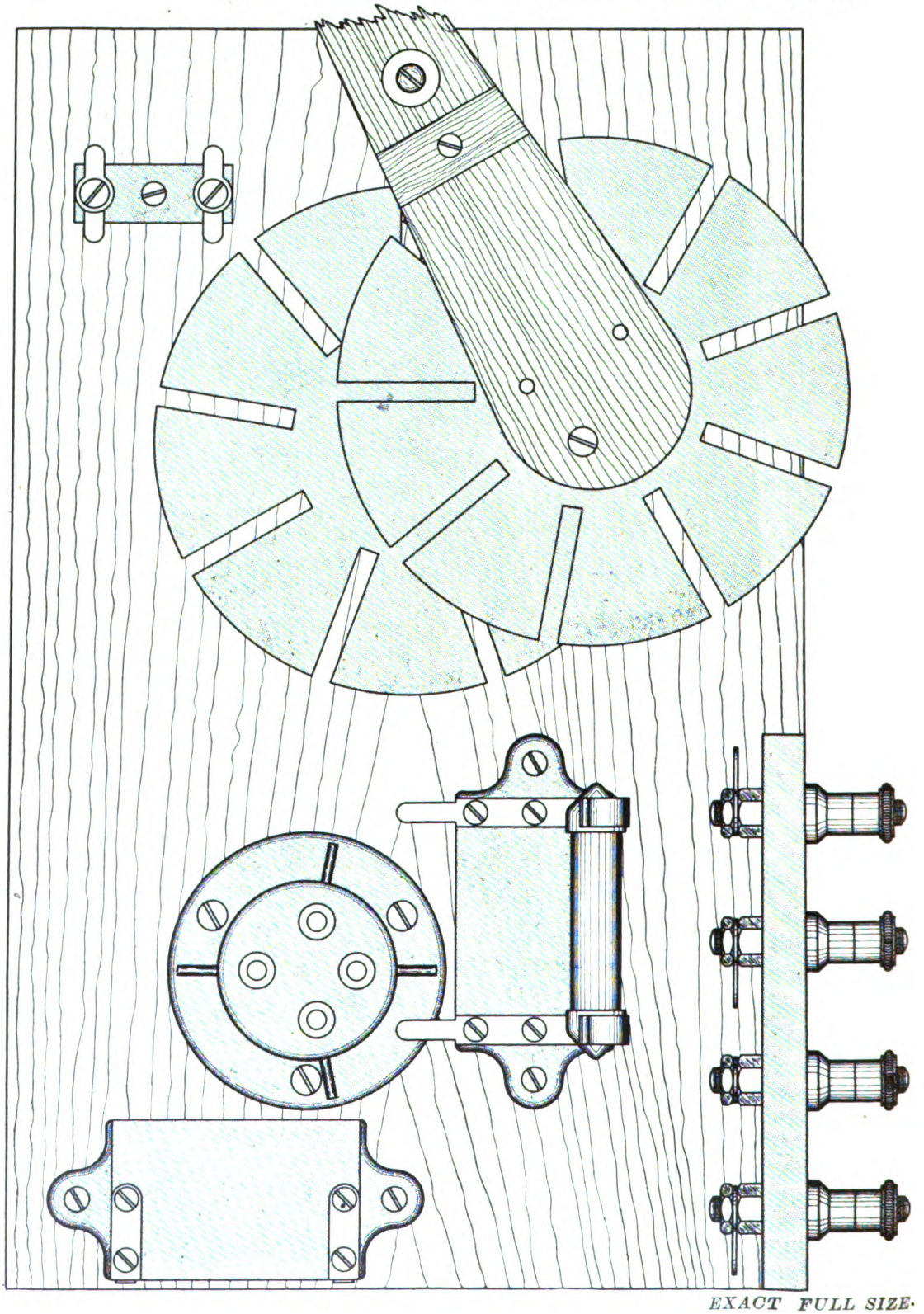

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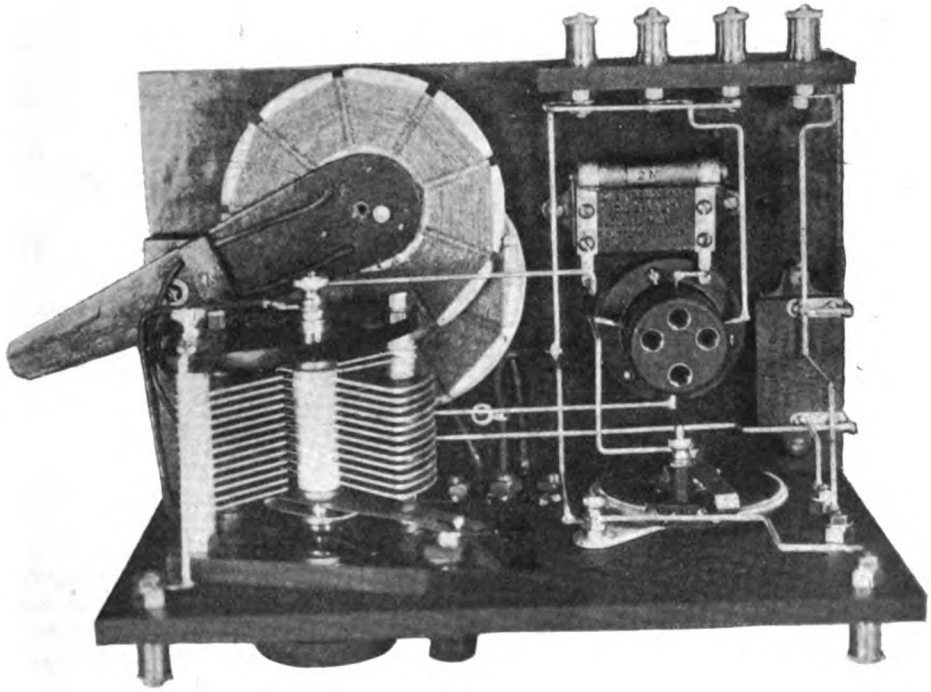
inductances secured to the base. Liberal clearance may be given, but this is governed, of course, by the amount of space available beneath the condenser. A thin piece of mahogany (cigar box wood) may be used for making the arm. The inductance is attached by means of three screws, and the arm pivots on a round-headed screw carrying a brass washer and mounted on a small block of wood to support it at the correct height.

When the other components are attached and the terminating pieces made for the flexible leads from the reaction coil essential to use connecting tags, for by so doing the overheating of components is avoided, and particularly is this important when, as in the case of the sockets, they are carried in ebonite. A good clean well-tinned iron must be used for soldering, and resin-cored solder will simplify the job, while the *merest trace* of " Fluxite " may be applied to the work. Only right-angle bends should be made in the wire. The connections to the reaction coil should be provisionally twisted off and not finally soldered until after the set has been put on test.



Back view showing the arrangement of the components

the set is ready for wiring. It might be mentioned, however, that when using the type of variable condenser illustrated it will be necessary to cut away portions of its ebonite mounting plate.

Connecting up is carried out with No. 16 tinned copper wire, and the practical wiring diagram can be followed. A length of wire should be paid out with one end attached to some secure object, then with the pliers gripping the wire a pull is exerted until the wire can be felt to appreciably stretch. It can then be cut up into lengths of about a yard each ready for use. It is almost

With all terminals joined up it will probably be found that self-oscillation will be produced with moderately loose coupling of the reaction coil. Owing to the large area presented between the moving and fixed inductances, self-oscillation will be set up not only by the inductive feed back, but also as a result of the capacity existing between the coils. Thus, the set will oscillate whichever way round the leads to the reaction coil are connected, though by changing the leads about one direction of connection will produce smoother and more easily managable reaction effects.

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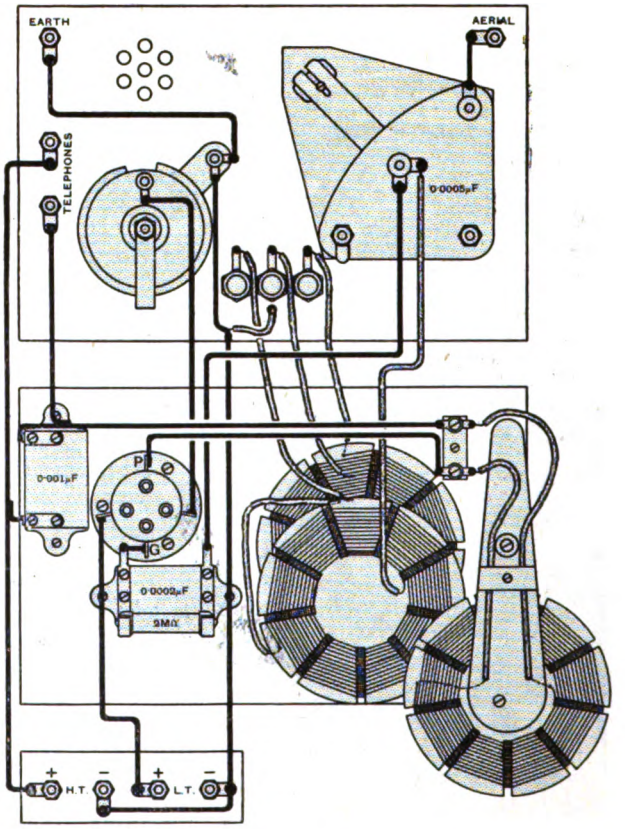
In operating the receiver it will almost immediately be observed that the reaction coupling has to be loosened as the capacity of the aerial tuning condenser is reduced. The series method of connecting the aerial tuning condenser used in this set readily stimulates self-oscillation, and at times in a somewhat erratic manner, rendering tuning a little difficult. One soon becomes acquainted with this peculiarity, however, and this system of connection is preferred to the parallel tuned circuit, in which the condenser is connected across the inductance, inasmuch as a greater signal potential is created across the ends of the coil.

For long range reception the receiver must be used in an oscillating condition, and although self-oscillation may distort, good intelligible telephony may be obtained on telephone receivers.

The question of the oscillating set causing interference can scarcely be discussed here, for all sets making use of reaction, however it may be arranged, will energise the aerial circuit in the course of adjustment. It would appear that an amateur, in foregoing the use of reaction, will be penalising himself, while the less technically interested listener, unskilled in the control of oscillation, is provided with apparatus arranged to oscillate. The principal cause of interference by oscillation is brought about by the continual adjustment of a set in the endeavour to tune in distant stations.



Practical wiring diagram. The under coil is shown displaced to expose the connections.

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MEASUREMENT OF AERIAL CURRENT.

DESCRIPTION OF AN IMPORTANT METHOD.

By N. W. McLACHLAN, D.Sc., M.I.E.E.

(*Concluded from page 275 of previous issue.*)

A Current Transformer.

A CURRENT transformer designed for 150 amperes at 10,000 metres would operate satisfactorily at 100 metres. In general a current of 150 amperes at 100 metres would cause undue heating of the secondary winding, but, as we have seen above, such currents at this wavelength are quite unusual.

Before dealing in detail with the design of iron-cored radio frequency current transformers, it will be well to state their advantages. These are as follows :—

1. They are accurate to 1 per cent. or less over a very wide range of wavelengths.
2. They are cheap and very easily constructed.
3. They can be placed within a few feet of an aerial tuning inductance, and although situated in a strong alternating magnetic field, there is no perceptible error if the primary and secondary are wound symmetrically to give astaticism.
4. For large currents the combination of a transformer and small ammeter is more economical and flexible than a large ammeter. It is also likely to be more accurate than either a multi-strip ammeter or one with a shunt, especially over a fairly wide range of wavelengths.
5. It is possible to have the primary of the transformer connected in the aerial earth lead, whilst the ammeter can be situated at a distance.* This facilitates handling the set for tuning purposes, since the instrument is placed in the position of optimum visibility. The ammeter ought always to be situated at a position in the circuit as near earth potential as possible.

Following a series of investigations into the magnetic behaviour of iron at radio frequencies,† the author outlined a simple theory of iron-cored current transformers.‡ This analysis showed that the transformation ratio, in the absence of capacity effects and of inductance in the secondary circuit, could be expressed by the formula—

$$\frac{I_1}{I_2} = \frac{n_2}{n_1}\left(1 + \frac{kR_2}{\omega L_2}\right),$$

where I_1 I_2 = r.m.s. primary and secondary currents respectively, n_1 n_2 = primary and secondary turns respectively, R_2 = resistance of the complete secondary circuit at radio frequency, k = factor depending upon the iron and L_2 = inductance of secondary winding.

For 0·25 or 0·5 mm. stalloy rings in which there is no air gap, k may be taken as unity, so that the formula becomes

$$\frac{I_1}{I_2} = \frac{n_2}{n_1}\left(1 + \frac{R_2}{\omega L_2}\right).$$

It is obvious that the error in the transformation ratio is $\frac{R_2}{\omega L_2}$. This means that the secondary current, as measured on the indicating instrument is $\frac{100\,R_2}{\omega L_2}$ per cent. *too small.* Morevoer, in designing a current transformer we must aim to make $\frac{100\,R_2}{\omega L_2}$ small compared with unity.

* The leads can be twin flex stranded, to avoid inductance and the effect of external fields, but care must be taken not to introduce excessive resistance or capacity. Assuming concentrated capacities the current due to the latter is 90 degs. out of phase with the main current and can be relatively large without introducing appreciable errors. The capacity is of course distributed and care would have to be taken when using (long) leads on short wavelengths owing to the possibility of nodes. The instrument can, of course, be calibrated with its leads.

† See references already quoted.

‡ *Electrician*, December 22nd, 1916, and *Wireless World*, July, 1917.

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Let us take a concrete case and design a transformer for a definite purpose. Assume the conditions to be as follows :—An aerial current of 50 amperes is to be measured at wavelengths from 1,500 to 500 metres, the accuracy being within 1 per cent. This means that in the above range the value of $\frac{R_2}{\omega L_2}$ must be less than 0·01. Equating $\frac{100\,R_2}{\omega L_2}$ to unity at the longer wavelength we have $\frac{R_2}{\omega L_2} = 0{\cdot}01$, or

$$L_2 = \frac{100\,R_2}{\omega} = \frac{100\,R_2}{2\pi \times 2 \times 10^5} = 8 \times 10^{-5} R_2.$$

Thus L_2 must not be less than $8 \times 10^{-5} R_2$. Now L_2 for an uniformly wound iron-cored anchor ring is approximately

$$\frac{4\pi n^2 A \mu_a}{l} = \frac{4n^2 A \mu_a}{d_m}$$

where A = cross section of iron, μ_a = apparent permeability of iron at radio frequency and d_m = mean diameter of ring. At radio frequencies the eddy currents in the iron are such that the magnetisation decreases rapidly as we pass from the skin to the interior of a plate, unless the latter be exceptionally thin. With stalloy plates either 0·25 or 0·5 mm. thick at a wavelength of 1,500 metres ($f = 2 \times 10^5$ cycles) the flux density at the centre is insignificant compared with that at the skin. At a certain depth below the skin the flux is in opposite phase to that at the surface. Suppose we pass an alternating current $f = 2 \times 10^5$ cycles through an anchor ring coil with a core of stalloy sheets. If we assume the voltage across the coil is sinusoidal in wave form and the resistance of the winding is negligible, it is possible to calculate the apparent flux density in the iron from the expression so familiar in power transformer design, namely, $V = 4{\cdot}44\,Afn\,B_{max} \times 10^{-8}$ where A = cross-sectional area of iron, f = frequency, B_{max} = apparent flux density in iron, n = turns on coil. B_{max} is really the maximum value of the flux density when uniformly distributed over a plate, which would give the same voltage across the coil as the actual non-uniformly distributed flux. Moreover, although the apparent flux density may be relatively small, it must be borne in mind that the density at the skin of a plate may be large.

In the experiments on the magnetic behaviour of iron at radio frequencies already cited, data was obtained from which it is possible to find the apparent permeability of the iron.§ The magnetising forces and apparent flux densities used in the experiments were in excess of those usually encountered in radio-frequency current transformers. The flux density in these is never more than, say, 10 lines per square centimetre when reading currents of 100 amperes or more. With smaller currents it is very much less than 10 lines per square centimetre. Thus, in order to obtain an approximate estimate of the apparent permeability it is essential to extrapolate with the author's experimental data. Although the values secured by this means are liable to error—because we must assume the "shape" of the permeability curve‖—they

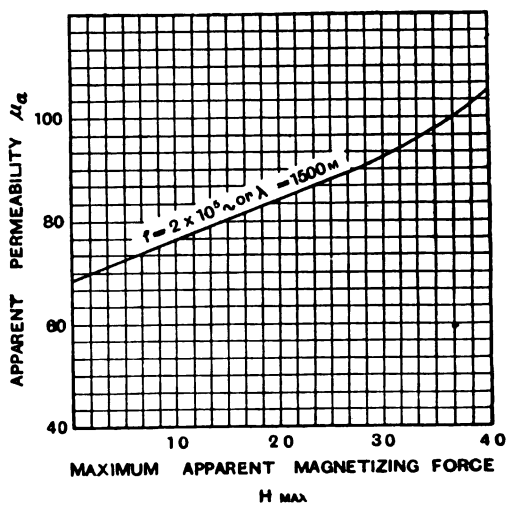

Fig. 4.

are a valuable guide for design. What we actually desire to design is a transformer in which the ratio $\frac{R_2}{\omega L_2}$ is a minimum for the range 1,500 to 500 metres. Now the value of R_2 at radio frequencies is not readily and accurately calculable, and furthermore the data for L_2 has been obtained by extra-

§ For a general article on iron at H.F. see p. 880 Year Book of W/T, 1918.

‖ The shape in the neighbourhood of the origin may be quite different from that at low frequencies, and is really a point which can only be settled empirically.

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polation and not directly from experiment. Thus the probability of finding the optimum $\frac{R_2}{\omega L_2}$ by computation is rather remote, and it is advisable to adopt an alternative mode of attack. If in the calculation of the transformer we allow a "factor of safety," the error in the transformation ratio will fall within the required limits. Proceeding on these lines, and assuming the value of R_2 to be 30 ohms, the factor of safety will probably be of the order of 2 to 3. We can therefore equate L_2 to $8 \times 10^{-5} \times 30 = 2{\cdot}4 \times 10^{-3}$ henry. Now

$$L_2 = \frac{4n^2 A \mu_a \times 10^{-9}}{d_m} \text{ henry.}$$

Assume the mean diameter of the stalloy rings to be 8 cm., the radial width 1 cm., and the thickness 0·25 mm. By using 80 rings the cross-sectional area of the iron will be 2 square centimetres. By extrapolation from Fig. 4 the apparent permeability of the iron is roughly 6 per cent. at a wavelength of 1,500 metres. Substituting the above data in the formula for L_2 we find that the number of turns required on the secondary winding is 200. Using a hot-wire ammeter reading to 1 ampere in the secondary circuit the ratio of transformation for a maximum primary current (r.m.s.) of 50 amperes is obviously 50/1, which means that the number of turns on the primary will be 4.

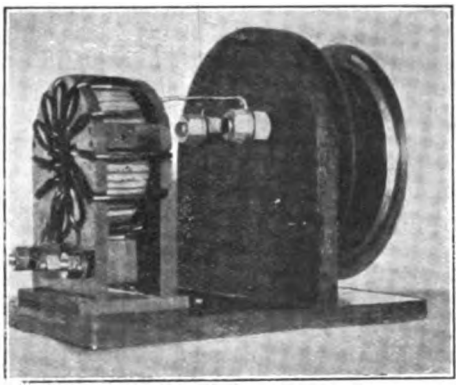

Fig. 5. View of the complete instrument, comprising a hot-wire ammeter and a current transformer.

Assuming the actual resistance of the secondary circuit to be 15 ohms, the voltage induced in it when the primary current is 50 amps must be $15 \times 1 = 15$ volts provided there is no leakage. Taking the formula $V = 4{\cdot}44\, Afn\, B_{max} \times 10^{-8}$, and inserting the known factors, we find that $B_{max} = 5$ lines per square centimetre. This is about 1/1000th the flux density at which a transformer would be operated at 50 cycles, and the loss in watts per kilogram is very small.

It is customary to use a secondary winding of one layer only, although there is no reason why multilayer coils should not be adopted, provided (1) the radio resistance can be kept adequately low, (2) the leakage is inappreciable, and (3) inherent capacity and resonant effects are avoided, and (4) the insulation between layers is satisfactory. In the present instance we shall legislate for a single layer secondary wound with solid D.C.C. copper wire. In calculating the overall diameter of the wire, allowance must be made for an insulating covering on the iron discs. The latter are varnished and bound together with thin tape. Two strips of leatheroid or suitable insulating material are fitted to the outer and inner curved surface of the core. These are wide enough to fold over the ends of the core, this operation being facilitated by a series of cuts parallel to the axis. The whole is again bound with strong silk tape, and then suitably varnished. There is then little chance of the rings cutting through the insulation. The inner diameter of the ring is now used as a basis for calculation. We shall suppose the insulation to be 2 mm. thick, so that the internal diameter is now 6·6 cm. The inner circumference is therefore 20·7 cm. Making allowance for the diameter of the wire, for spaces which inevitably occur during winding, and for a distance piece between the first and last turns, this being essential, since, on open circuit there may be several thousand volts across the secondary, the inner circumference may be regarded as 20 cm. Since there are 200 turns, the diameter of the wire over the insulation can be as large as 0·1 cm., *i.e.*, 0·04 in.

From standard tables we find that the wire is No. 20 D.S.C.; the D.C. resistance of the secondary winding will be approximately 0·4 ohm. If the radio frequency resistance were so large that undue heating occurred, the ratio of transformation could be increased

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to 100, thereby halving both the primary turns and the secondary current. A hot wire instrument would then be used reading to a maximum of about 0·5 ampere. The appearance of the complete transformer would be somewhat akin to that shown in Fig. 5. The ring is mounted on an insulated framework of stabilite, ebonite or bakelite, and the primary is wound over it and kept in position by the framework.

The type of winding for the primary circuit is rather problematic. It is desirable to keep the primary resistance as small as possible. Now it is usually found in practice that the resistance of stranded wire at a wavelength of 500 metres is much greater than one would expect from calculation. Moreover, it would appear that in our particular case solid wire for tube is a better proposition. The objections to this are twofold—(1) it is much more difficult to wind, (2) if the secondary breaks down the primary is difficult to remove. However, we cannot have it both ways. Although it is possible, especially when the primary turns are few in number, to use a relatively small size of solid wire and wind several in parallel spaced radially in slots round the periphery, this course may lead to relatively high resistance if all the parallel paths are not electrically identical. This, however, is a question of accurate workmanship.

Following standard power practice, a cable can be run straight through the centre of the ring, thereby giving a one turn primary. This gives good results in some cases, and is a good method when hundreds of amperes are to be measured. Unless proper precautions are taken the readings are more likely to be influenced by external fields than those where the primary consists of more than one turn. In the latter instance, if the turns are equal in size and equally spaced, the arrangement acts astatically, and is practically immune from the action of external fields. A single turn primary can be made astatic by *closing the turn at the transformer* and using two or more parallel paths round the core, the turns being electrically identical and symmetrically spaced. Care must be taken to avoid strong external fields, or there may be a large current circulating round the parallel strands. Moreover, the type of primary winding must be settled having due regard to the various factors which are brought into play. If the transformer is properly constructed so that the possibility of puncture of the insulation between the secondary and the core or between the ends of the secondary is remote, there is justification in the present design for using a solid wire primary of several turns in parallel, say six of No. 10 S.W.G. The primary will therefore consist of six equal lengths of No. 10 bare wire equally spaced, and each taking four turns round the core, being just sufficiently removed from the secondary to give satisfactory insulating requirements. The six wires should preferably be equally spaced, and sweated at their extremities to the external cylindrical surface of a socket. This is probably better than sweating the wires into the hole of the socket, although in practice one cannot always adhere to the optimum conditions.

Where there are many strands of fine wire, the above procedure enables one to see whether *all* the strands are connected.

NEW FRENCH WIRELESS DECREE.

The new French Decree concerning wireless installations on mercantile marine and fishing craft, which will come into force on March 15th, 1925, will particularly affect many of the smaller British cargo boats which call at French ports.

For the purpose of the Decree, ships are divided into two sections—(1) Ships of 2,000 gross tons or more, ships carrying 50 souls (including crew), and ships having more than 12 passengers; and (2) Ships of 500 to 1,999 gross tons with less than 50 souls, and ships of like tonnage with not more than 12 passengers.

All ships in section (1) must carry a complete wireless telegraph installation. Ships in section (2) may carry a wireless receiver only. The British regulations now in force only insist that wireless apparatus shall be carried in passenger steamers or in steamers of 1,600 gross tons and upwards.

It follows that all British vessels between 500 and 1,600 tons which use the French ports, although exempt from the British wireless regulations, will be compelled under the new regulations to carry a wireless receiver at least. Of course, many of these smaller ships already carry Marconi apparatus, not as a compulsory measure, but for the sake of the many advantages it brings them, and especially the assistance it renders to navigation.

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THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

Valves and "Amplifying Power."

VALVE users are naturally very interested in the "amplifying power" of their valves. They find that one valve, when used for instance in a high frequency stage, results in stronger signals than when another valve is tried. The tendency to oscillate is less with one valve than with another. Perhaps the valve which gives better results when used in the high-frequency stage gives poorer results than another when used in a low-frequency stage.

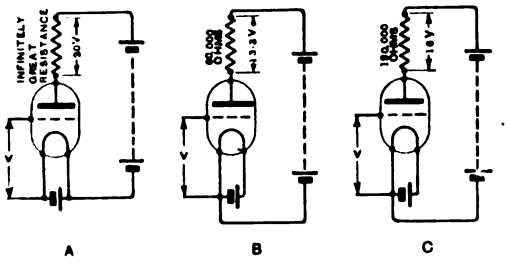

Fig. 1. Showing the amplification obtained when the valve has an impedance of 30,000 ohms and an amplification factor of 20.

It is found that one type of valve gives louder signals when employed in a resistance or choke coupled amplifier, and weaker signals if used in a transformer coupled amplifier.

Probably the experimenter notices a difference in the quality of the signal when different valves are tried.

Thus we conclude that the effectiveness of the amplifier depends partly on the valve and partly on the method of coupling. Valves which are suitable for use in an amplifier employing one form of coupling are not so suitable for use in amplifiers in which a different type of coupling is employed.

The "amplifying power" mentioned above is therefore not decided by the valve alone. The valve is but a part of the amplifier, and to do its work properly must be employed with correctly designed circuits. Perhaps it would be better to express this in another way, and to say that the *valve* should be chosen with regard to the work it must do.

The Amplification Factor of a Valve.

Before we can choose the most suitable valve for use in one of the amplifying stages of a receiver, it is necessary to understand the characteristics and properties of the valve itself. Naturally, it is important to know the amplification factor of a valve to be used in an amplifier.

The amplification factor (sometimes referred to as the "*m*" value) depends principally on the construction of the valve. It depends, for instance, on the position of the grid with respect to the anode, the number of wires in the grid, and the size of the grid wires. If the number of wires in the grid is increased, there is a corresponding increase in the amplification factor, and the same result is obtained by increasing the distance between the grid and the anode.

The value of the anode voltage usually affects the amplification factor slightly; it falls a little as the anode voltage is reduced. Adjustment of the filament current (about the normal value) may also have a slight effect on the amplification factor.

The amplification factor referred to here is the ratio of the voltage set up in the anode circuit to the voltage applied to the grid, the anode circuit being designed to have the highest possible voltage set up in it (Fig. 1). This value of amplification factor is sometimes referred to as the "theoretical" voltage amplification factor of the valve. In an ordinary resistance-capacity coupled amplifier, for instance, the actual voltage amplification obtained might only be 60 per cent. of the theoretical value; an amplification of higher than 80 per cent. of the maximum is not usually obtained—not because it is impossible to secure a higher degree of amplification, but because it is not economical to do so. The amplification actually obtained would be equal to the voltage amplification factor of the valve

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when the value of the resistance connected in the anode circuit is infinitely great.

These facts will more readily be appreciated by referring to Fig. 1. In the figure we have a valve which, we will assume, has a theoretical amplification factor of 20, and an impedance (this property of the valve will be explained later) of 30,000 ohms. In Fig. 1A the resistance connected in the anode circuit has an infinitely great value of resistance. Therefore the voltage amplification actually obtained is equal to the voltage amplification factor of the valve. If v volts are applied to the grid, a voltage of 20 v volts are set up in the anode circuit. In Fig. 1B and 1C the anode resistances have values of 60,000 ohms and 120,000 ohms respectively. These are usual values for a valve with these characteristics. The actual amplification obtained is 13·3 for the arrangement of Fig. 1B, and 18 for Fig. 1C. That is, if 1 volt is applied to the grid of the valve in Fig. 1B, a voltage of 13·3 volts is set up in the anode circuit, or 18 volts with the arrangement of Fig. 1C.

Finding the Amplification Factor.

There is another way of considering the amplification factor of a valve. In Fig. 2 is given *static* characteristic curves of a valve showing the relationship of anode current to grid voltage, the filament current being of sufficient value to prevent the saturation point being reached.

These curves may be obtained in the following simple manner. Connect in the anode circuit of the valve (Fig. 3) a milliammeter mA, reading up to, say, 10-15 milliamperes, and a dry cell battery of known voltage V. In the grid circuit connect a few cells (GB) so that the grid voltage, as read by the voltmeter VG, may be varied between, say, 15 volts negative and a few volts positive. Adjust the filament current to its normal value, and fix the anode voltage at, say, 40 volts. Then read off the anode current for various grid voltages, and tabulate the results. The results may be plotted to give a curve such as those of Fig. 2 by marking off on squared paper the anode current corresponding to the grid voltages, and drawing a line through the points.

Having obtained a curve showing the relation between the anode current and grid volts for an anode voltage of 40, increase the anode voltage to, say, 60 volts, and get the figures for another curve. Repeat the experiment for various anode voltages, in all cases increasing the negative voltage of the grid to the point where the anode current falls to approximately zero. The portion of the curve to the right-hand side of the line representing zero grid volts is not of much interest, because it is usual to operate amplifying valves so that the grid does not become positive.

Now that we have a set of curves showing the relationship of anode current and grid volts we can see the effect of the amplifying property of a valve. For instance, referring to the set of curves of Fig. 2, the line A B

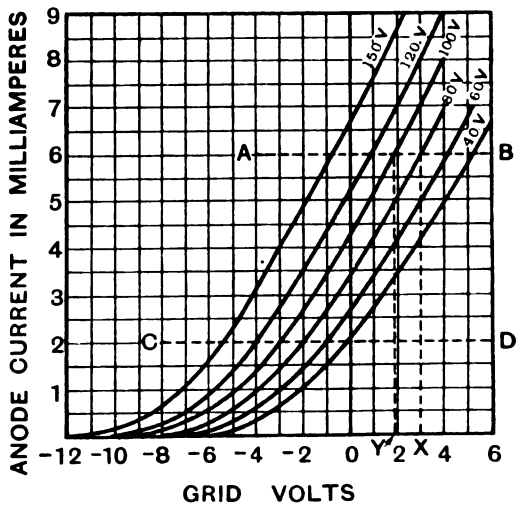

Fig. 2. One method of finding the amplification factor. The static characteristic curves show the relationship of anode current to give volts at various anode voltages.

cuts all the curves at an anode current of 6 mA. At this value the valve may have an anode voltage of 150 and a grid voltage of −0·8, an anode voltage of 120 and a grid voltage of + 0·8, or 100 volts and + 1·9 or 80 volts and + 3.

At point Y, the anode voltage is 100, and the grid voltage is + 1·9. If the grid voltage is increased by 1·1 volts, making a total grid voltage of + 3 volts, at point X, the anode current increases to 7 mA. To reduce the anode current to 6 mA it is necessary to reduce the anode voltage to 80 volts. That is to say, the effect on the

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anode current of adding 1·1 volts to the grid may be counteracted by reducing the anode voltage by 20 volts. A voltage applied to the grid is therefore $\frac{20}{1\cdot1} = 18\cdot2$ times more effective in producing a change in the anode current than a similar voltage change in the anode volts.

The amplification factor of the valve when the anode voltage is 100 and the grid voltage + 1·8 is therefore 18·2.

The Average Value of the Amplification Factor.

The amplification factor of the valve may be obtained from the curves for various average grid voltages. Thus, considering line AB, the amplification factors when the grid has voltages of — 0·8, + 0·8, + 1·9 and + 3 volts, are 18·7, 18·2, 18·2 and 18·2 respectively. If we consider line CD and grid voltages — 5·5, — 4, — 3, — 2 and — 1, we find the values of amplification factor to be 20 in each instance.

Another Method of Finding the Amplification Factor.

Instead of determining the amplification factor as above by finding from the curves the ratio of the anode and grid volts for constant anode current we may use the following method.

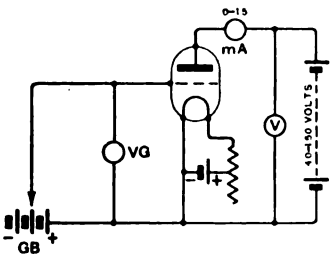

Fig. 3. The connections of the apparatus required when finding the figures for the characteristic curves of Figs. 2 and 3.

Draw a straight line AB through the curves (Fig. 4), and draw lines CD, EF, GH, etc., to scale to represent the anode voltage of the curves. Thus CD represents to scale an anode voltage of 150 volts, EF 120 volts, GH 100 volts, and so on. Now draw a straight line through the points. This line cuts the grid voltage line at Y.

The amplification factor of the valve may now be obtained by dividing the anode voltage by the grid voltage represented by the distance between point Y and the point where the line drawn down from the anode voltage cuts the grid voltage line. For instance, when the anode voltage is 150 the grid voltage is represented by the distance between points Y and C, or 8·0 volts. The

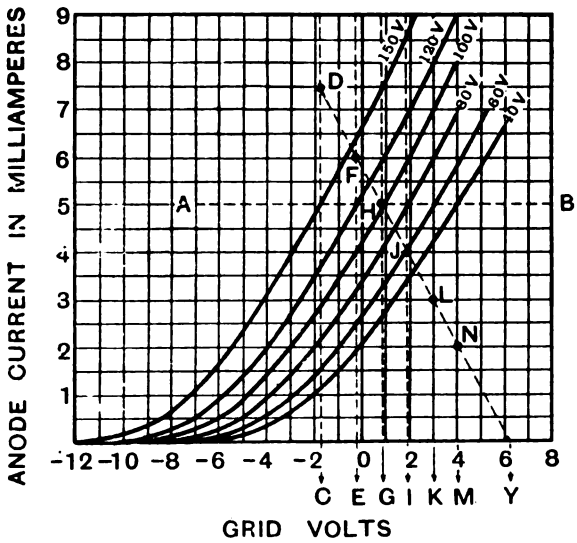

Fig. 4. Explaining another method of finding the amplification factor of the valve.

amplification factor is therefore $\frac{150}{8}$ or 18.7·

If we take an anode voltage of 100 the grid voltage (Y to G) is 5·3, and the amplification factor $\frac{100}{5\cdot3}$ or 18·8.

If the curves are drawn on a large sheet of squared paper the average value of amplification factor may easily and accurately be obtained.

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A COIL WINDING MACHINE.

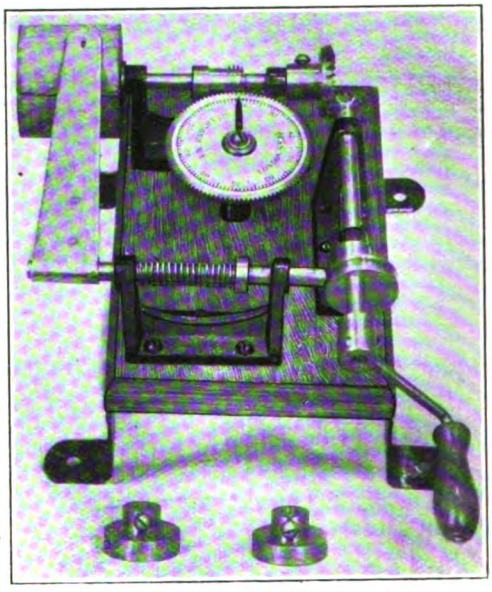
Those who do considerable experimental work and use a number of multi-layer coils will be interested in the simple winding machine described below.

MANY readers may remember that some three years ago a description was published of a coil winding machine, and since that time these winders have been in fairly general use by amateurs for the construction of tuning coils. Some recent improvements have, however, been made, and the machine in its latest form is shown in Fig. 1.

The general construction will be seen to consist of a geared drive operating a wooden drum and fitted with a cam which causes an arm to oscillate for the purpose of zig-zagging the wire across the drum as its revolves. The instrument is rigidly set up, which is a very necessary feature, for any play which may exist in the pinions gives rise to a little slackness of the wire at the edge of the coil under construction and results in the turns falling off.

The winder is supplied with a booklet of instructions containing much useful information on the process of winding coils and the many applications in which they may be used. It gives the number of turns to produce coils of given inductance, and in the tabular matter states the self capacity that these coils will probably possess.

It may be mentioned that when operating a machine of this sort the wire must be pulled quite taut and the oscillating arm kept pressed hard against the cam. A very useful feature which has been added to the machine is the dial counter, which indicates the number of revolutions made by the revolving drum, and indicates the size of the coil more readily than the method of counting the rotations of the handle. Although wire of both fine and comparatively heavy gauge may be wound it will be found that No. 26 D.C.C. can be handled quite easily, as it takes the necessary bend without being too stiff, and the thick insulation gives a certain useful springiness to the layers of the coil.



The "Kaynite" coil winding machine manufactured by A. W. Knight, Ltd.

Particulars of coils wound with this wire are given in the following table :—

Turns of Handle of Machine.	Turns of Wire on Coil.	Self Capacity $\mu\mu$F.	Inductance.	Maximum Wavelength with 0.001 μF Condenser. *Metres.*
100	48	21	0.165	771
200	96	19	0.74	1,585
300	144	14	1.60	2,380
400	192	14	2.76	,150
500	240	13	3.82	3,720
800	384	10	11.15	6,400
1,?00	576	9	30.10	10,450
1,600	768	9	55.70	13,800

This useful machine is worthy of a place in the laboratory of every experimenter.

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A rumour to the effect that the French Government has been considering the advisability of making wireless transmission a State monopoly has now been denied in Paris.

* * * *

A wireless club has been formed at Rangoon and the members are constructing a transmitter.

* * * *

Strong reception of the American broadcasting station **WFI**, at Philadelphia, Pa., is reported by a Lancashire reader. **WFI** operates on 395 metres and is worth an attempt to hear.

* * * *

A second series of B.B.C. Symphony Concerts will open on December 10th. On this occasion M. Pierre Monteux will conduct a large orchestra at the Opera House, Covent Garden, the concert being simultaneously broadcast to all stations, except Belfast.

* * * *

Music is not at present being relayed to the Belfast station owing to the inherent difficulties in transmission over submarine cable.

* * * *

We are now in possession of a complete list of New Zealand amateur transmitters, with call signs and other particulars. Readers interested should apply for a copy.

* * * *

TELEPHONY TESTS FROM s.s. "LEVIATHAN."

The reception of broadcast music from the s.s. "Leviathan" (**WSM**) is reported by Mr. E. A. Richardson, who tuned in the vessel at 12.5 a.m. on November 20th, when its position was given as 70 miles west of Cuba. In addition to gramophone records, which included "It Ain't Gonna Rain no More," messages were transmitted to **WML** and **KDL**, and the hope was expressed that British and Canadian amateurs would be successful in receiving the transmissions. The "Leviathan" was also heard by Mr. A. H. Brackensey on Sunday, November 16th, but it is probable that a considerable distance has been covered by the ship since then.

2 OD's FURTHER SUCCESS.

Mr. E. J. Simmonds (**2 OD**), of Gerrard's Cross, Bucks, secured further successes in two-way communication with Australia, when, on November 24th, he worked with two Australians in the space of half-an-hour. **A 2 DS** was first heard at 6.15 p.m., G.M.T., calling CQ. At 6.30 **2 OD** replied, and two-way communication was at once established, **2 OD's** signals being reported as very strong. At 6.55 p.m. **2 DS** said, "Please now listen to **A 2 CM**." Signals were immediately received from the latter station, and two-way communication was effected at 7.5 p.m. Five minutes later Mr. Simmonds received the following message from **A 2 CM**. "To His Majesty the King, Greetings from Australian Radio Experimenters. (Signed) Maclurchan, President of Wireless Institute of Australia." The tests concluded at 7.35 p.m. with the message of **A 2 CM**, "The sun is up now."

Mr. Simmonds has now worked direct with Australia on four occasions.

On November 23rd Mr. Simmonds established two-way communication with **U 5 UK**, this being the first occasion on which an American fifth district station has been worked from Great Britain.

FIRST POLISH RADIO CLUB.

The first Radio Club to be founded in Poland is that just organised in Poznau. The main object of the club is to arouse interest in wireless communication throughout Poland, and to foster the development of the radio industry. In addition to holding lectures and demonstrations, the Poznau Wireless Club itself will sell radio apparatus and appliances, on a commission basis. As the wireless industry is in its infancy in Poland, there is evidently a big scope for British manufacturers to find a considerable new market, though competition from German makers will doubtless be very keen. The club will also publish a magazine dealing with, explaining, and encouraging the use of wireless installations in Poland.

NEW TRANSPACIFIC WIRELESS SERVICE.

A high speed wireless service will shortly become operative between the Pacific Coast of America, Honolulu, the Far East and all points in the Pacific, following the erection of a powerful transmitter at Bolinas, California. The station will be equipped with Alexanderson high frequency alternators and six self-supporting towers, each 650 ft. high.

FRENCH SHORT WAVE TESTS.

Some interesting experiments in transmission and reception on wavelengths between 40 and 80 metres have been conducted by the two well-

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known French amateurs, M. Menars of Le Blancat Gan, and M. Deloy of Nice. According to reports these experiments would go to show that on this band of wavelengths it is possible to transmit over distances quite as great during the day as during the night; in fact it was observed during the experiments that audibility was sometimes greater during the day.

HIGHEST BROADCASTING STATION ?

Said to be the highest in the world, the new wireless station on the Pie du Midi, in the Pyrenees near Tarbes, has undergone its initial trials, which were carried out in spite of the fact that the pylons 100 ft. high, which were to have supported the aerial, could not be taken to the summit of the mountain, so a temporary aerial had accordingly to be used.

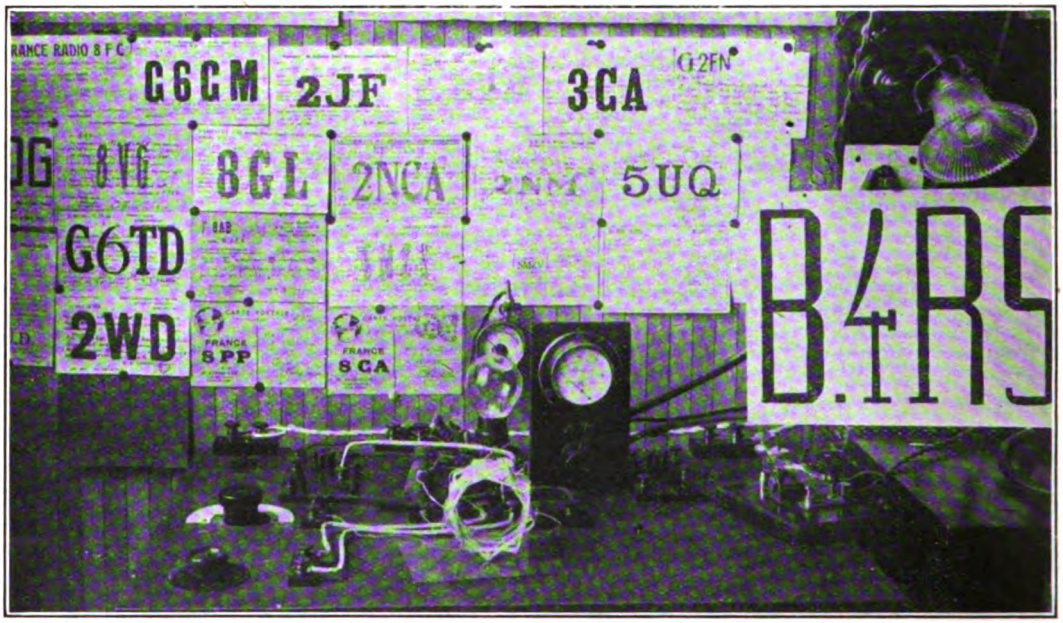
Besides keeping permanent touch with Bagneves, the new station will be extensively used for broadcasting weather reports.

SHORT WAVE SIGNALS FROM NKF.

With reference to the note in our last issue giving the schedule of 54-metre signals from the United States Naval Research Laboratory, **NKF**, at Bellevue, Anacostia (D.C.), we have received an interesting report of the reception of these tests from **Mr. C. M. Denny (6 DIV)**, of Bebington, Cheshire. Our correspondent states that he has recently been receiving these signals at good strength on a straightforward single valve reaction circuit, the receiver being installed in a Belfast hotel, and the aerial being only 6 ft. long, suspended 1 ft. from the ceiling.

RADIO SMUGGLING IN BULGARIA.

As a direct result of the strict prohibition of private wireless in Bulgaria the smuggling of wireless receiving sets has recently become a practice in the various parts of the country. Under the pressure of powerful foreign radio interests the Bulgarian Government are considering the possibility of introducing radio under strict official supervision. It is thought that a Bill will shortly be introduced in the Bulgarian Parliament giving the Ministry of Posts, Telegraphs and Telephones discretionary powers in the matter of wireless broadcasting. It is understood that the monopoly of broadcasting will remain with Bulgarian companies.



A well-known Belgian amateur transmitting station (**4RS**), *is extremely active, as may be judged from the "QSL" cards. His aerial consists of a twelve-wire cage,* 160 *feet long and* 60 *feet high.*

CHILI—U.S.A. AMATEUR WORKING.

Messages exchanged during two-way communication between Chili and the United States were intercepted by Mr. E. J. Simmonds **(2 OD)**, of Gerrard's Cross, Bucks, at 7 a.m., on November 18th. The stations participating were **R 9 TC** calling CQ on 85 metres, and **6 CGO**. The following cryptic message was transmitted at 7.15 a.m., "Quist, Hartford. Credit **6 CGO** one Chilian hat. (Signed) Ravithart."

R.S.G.B. INFORMAL MEETING.

An Informal Meeting of the Radio Society of Great Britain will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6 p.m. on Wednesday, December 10th, when Mr. W. K. Alford will give a talk on the "Supersonic Heterodyne."

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AN EFFICIENT TRANSMITTER.

Operating on an average power of 250 watts, Mr. J. H. Ridley (**5 NN**) of South Norwood, has, since October 5th, worked with the following American and Colonial amateurs :—

U 1 AJW, U 1 BGQ, U 3 AJD, U 1 MY, U 3 BHV, U 1 SF, U 2 ABD, C 3 BG, C 2 CG, Z 4 AK, Z 2 AC, Z 4 AG.

5 NN has also received a report from Californian **6 BUR** that his signals were heard on November 1st ; this has been confirmed and checks exactly with the log at **5 NN.**

NOT AN AUSTRALIAN.

The report in a recent issue of the reception of an Australian amateur by Mr. W. J. Randall has led to some doubt, as at present no 8th District exists in Australia. It is probable that the station heard was **U 8 GZ** (Columbus, Ohio), which is frequently heard in this country on the 75-80 metre band.

AN INGENIOUS MODEL.

The value of mechanical analogy in wireless instruction was demonstrated at the last Informal Meeting of the R.S.G.B. when Mr. R. C. Clinker exhibited a dynamical model of an oscillating valve circuit.

Opening his talk with some interesting historical notes, Mr. Clinker referred to Clerk Maxwell's early model designed to show the mutual inductance between two circuits. This model had evoked the admiration of Lord Kelvin, whose belief it was that if any electrical phenomenon was fully comprehended, it should be possible to construct a mechanical model to illustrate it.

Mr. Clinker's model consisted of a simple circuit comprising a three-electrode valve placed across an aerial inductance tuned with a parallel condenser. The current flowing through the circuit was represented by a moving string, running on pulleys and actuated by a small electric motor. The inductance of the coil was illustrated by the use of a pivotted rod weighted at each end. When this was mechanically oscillated the inertia of the coil was at once apparent. Equally ingenious was the representation of the condenser capacity by means of an elastic spring.

When the circuit was represented in a state of oscillation, the grid was seen to change in polarity in accordance with the direction of the aerial current, and in other respects the action of the model was perfectly consistent with the electrical phenomena it portrayed.

In the ensuing discussion Mr. R. E. H. Carpenter detailed an interesting mechanical model to show the internal action of the valve, but stated that so far he had been unable to evolve a satisfactory device to represent the space charge effect. Mr. J. H. Reeves urged the need of a mechanical model to instruct broadcast listeners in the proper use of reaction.

G 2 AWD.

If **G 2 AWD** will kindly communicate his address to Mr. W. D. Keiller (**6 HR**), c/o the offices of this Journal, he will receive a souvenir card relating to his reception of **1 HT's** signals during the latter's recent voyage to the Argentine.

Calls Heard

Jersey (during October).
French : **8 BF, 8 BO, 8 BN, 8 BRG, 8 BU, 8 BV, 8 CA, 8 CB, 8 CKF, 8 CM, 8 CN, 8 CS, 8 CT, 8 CZ, 8 DA, 8 DP, 8 DW, 8 EK, 8 EM, 8 EN, 8 EP, 8 EU, 8 EX, 8 FK, 8 FN, 8 GF, 8 GH, 8 GI, 8 GUT, 8 HSF, 8 HSR, 8 HZX, 8 IP, 8 JBL, 8 JBR, 8 JV, 8 KC, 8 KN, 8 LI, 8 LPX, 8 MN, 8 NS, 8 OSO, 8 PA, 8 PD, 8 PP, 8 QG, 8 RBR, 8 RK, 8 RQ, 8 SG, 8 SM, 8 SR, 8 SSH, 8 SSU, 8 TPC, 8 UT, 8 WK, 8 WL, 8 WY, 8 WZ, 8 XH, 8 XR, 8 ZM, 8 ZU, 8 ZUT, 8 ZZ.** Belgian : **4 GP, 4 KT, 4 QS, 4 UU, 4 YZ, W 1, W 2, B 7.** Danish : **7 EC.** Dutch : **0 BA, 0 BQ, 0 II, 0 KN, 0 KZ, 0 OW, 0 SK, 0 TP, 0 XQ, 0 XY.** Italian : **1 FP.** Swedish : **SMZV, SMZY.** Luxembourg : **1 JW.** Canadian : **1 MY.** American : **1 FD, 1 GV, 1 IOK, 1 KC, 1 SF, 2 AAY, 3 BG, 3 CES, 3 GG, 3 WB.** Argentine : **CB 8.** Various : **3 CA, 3 CM, FAR 3, 1 OKZ, FGH, FL, HBS, ICS, IDO, IHT, LPZ, POZ, MO, UFT 1, WGH, YA 77, KDKA.** (o-v-1.) (D. Grove-White, **2 AWD.**)

Richmond, Surrey (September 27th to October 27th).
French : **8 AG, 8 AJ, 8 AQ, 8 BN, 8 BP, 8 BR, 8 BRG, 8 CA, 8 CL, 8 CM, 8 CN, 8 CO, 8 CZ, 8 DA, 8 DS, 8 EP, 8 EU, 8 EX, 8 FK, 8 FP, 8 FS, 8 GD, 8 GE, 8 GGA, 8 GI, 8 HSF, 8 JBL, 8 JHL, 8 KK, 8 NS, 8 PA, 8 PD, 8 PP, 8 QQ, 8 RBR, 8 SG, 8 SM, 8 SR, 8 SSU, 8 UU, 8 VV, 8 WAL, 8 XH, 8 XV, 8 ZUT, 3 DAX, 3 XO.** Belgian : **4 C 2, 4 LA, 4 QS, 4 VS, 4 UU, 4 YZ, B 7.** Dutch : **0 BA, 0 BU, 0 II, 0 MS, 0 OX.** Danish : **7 EC, 7 ZM.** Swedish **SMZP, SMZV, SMZY.** Finnish : **1 NA, 2 NC, 2 NM.** Luxembourg : **1 JW.** Algerian : **HBS.** Italian : **1 GN, 1 FP, 1 MT, 1 DO,** American : **1 ABF, 1 ABL, 1 ATJ, 1 AWQ, 1 AXD, 1 BGQ, 1 BMP, 1 ER, 1 GR, 1 KC, 1 XAV, 1 XAW, 1 XAX, 1 XW, 2 AAY, 2 ANA, 2 BCF, 2 BCO, 2 BUY, 2 BY, 2 BRB, 2 CV, 2 KJ, 3 AJD, 3 AMF, 3 BDO, 3 CC, 4 QF, 4 SA, 8 XBC, 9 ELD.** Canadian : **1 AR, 2 CY, 3 LY.** New Zealand : **4 AG** (October 16th). Miscellaneous : **9 AD, PK, XOX, YA 73.** (C. C. Buckle).

Nice, France (September 27th to October 31st, all about 100 metres).
Belgian : **4 AA, 4 Q 1,* 4 RS,* W 2.** American : **1 AAC, 1 CGQ, 1 II, 1 SF, 1 XAV, 2 AAY, 3 ZW, 4 XI, 5 UK.** French : **8 AP, 8 BG, 8 BN,* 8 BRG,* 8 BU, 8 CA, 8 CM, 8 CS, 8 CZ, 8 DA, 8 DP, 8 DS, 8 DY, 8 ÉE, 8 ÉW, 8 FJ,* 8 FS, 8 FV,* 8 GIF, 8 JBL, 8 MN, 8 MU, 8 NS, 8 PA, 8 PP, 8 QS, 8 RM, 8 SM, 8 SMP, 8 SR,* 8 SU, 8 UU, 8 VV, 8 WAA, 8 WAL, 8 XG, 8 XH,* 8 XR, 8 ZM, HBS, OCDJ, OCTU.** Finnish : **2 NM.** British : **2 CV, 2 DX,* 2 FN, 2 KF, 2 NM, 2 WJ, 2 ZG, 5 LF, 5 NN, 5 SI, 5 SZ, 5 UQ, 6 AI, 6 NF, 6 RY, 6 TM.** Dutch : **0 BA, 0 KN.** Italian : **1 MT, 1 TR, 1 CD, 1 HT,* MM, MS, SP.** New Zealand : **4 AK.*** Argentine : **DA 8*.** Miscellaneous : **3 AF, 3 MB, 10 KZ.** * Worked. (1-v-0) (Leon Deloy.)

East Aberthaw, nr. Cardiff, Glam. (during October).
Swiss : **4 YZ, 9 AB, 9 AD.** French : **8 AG, 8 AL, 8 BA, 8 BN, 8 BP, 8 BU, 8 CA, 8 CO, 8 CM, 8 CN, 8 CT, 8 CZ, 8 DE, 8 DP, 8 ÉM, 8 ÉP, 8 ÉU, 8 ÉV, 8 FK, 8 GI, 8 HI, 8 JV, 8 MN, 8 MZ, 8 ND, 8 NS, 8 PA, 8 PD, 8 PP, 8 PR, 8 QG, 8 SM, 8 SR, 8 WA, 8 WK, 8 WL, 8 WZ, 8 XH, 8 ZM, 8 ZZ, 8 BRG, 8 JHL, 8 FFU, 8 SSU, 8 SSH, 8 WAL, 8 ZUT.** Finnish : **3 NB.** Dutch : **0 AB, 0 BA, 0 BQ, 0 DP, 0 II, 0 SK, 0 HP.** Belgian : **4 GP, 4 RS, 4 UU.** Swedish : **SMZV, SMZY, SMZZ.** Danish : **7 ZM, 7 PU.** Italian : **1 FP, 3 AF, 3 MC, ICS, IHT, IDO.** Unknown : **3 CM, 3 DAX, 3 VO, 3 XO, WGH, WRT, KR 3, B 8.** (o-v-o and o-v-1). (C. Prosser, **2 ACK**).

5 JX MOVES.

Mr. Marcus G. Scroggie (**5 JX**), late of Edinburgh, informs us that he has now removed to "Venton," 19 St. Mildred's Road, Lee, London, S.E.12. He welcomes reports on his transmissions from the new address.

6 QB's TRANSMISSIONS.

Mr. L. H. Thomas (**6 QB**), writes that he is now transmitting almost every evening on a power of 5 watts, I.C.W. on short waves. He would be glad to receive reports at 33 Harpenden Road, West Norwood, S.E.27, and to arrange tests with other transmitters.

WHO IS W 1 PL ?

Mr. P. H. Brigstock Trasler, of Northampton, enquires whether readers of this journal can shed information on the identity of a station **W 1 PL** calling CQ at 4.10 G.M.T. on the morning of November 10th. The wavelength was about 80 metres.

2 KK.

The above call sign, originally owned by a London transmitter, has been allotted to Mr. Ralph H. Parker, of Wilson Road, Smethwick, Staffs. Reports of signals are welcomed.

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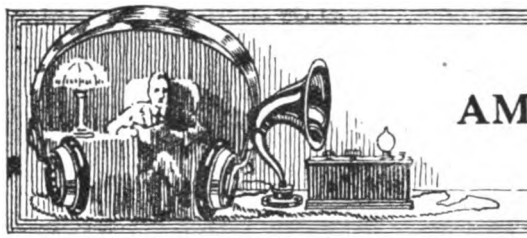

AMONG THE SOCIETIES.

At the opening meeting of the newly-formed Dorking and District Radio Society, Mr. R. J. Hibberd gave a useful introductory lecture on "The Development of Wireless." The lecturer traced the gradual evolution of the art, mentioning the work of Michael Faraday, Joseph Henry, Lindsay, Maxwell and others, up to the time of Marconi. He concluded with some interesting details of the earlier experiments in wireless telephony carried out in conjunction with aeroplanes at Brooklands in 1915.

* * * *

The Committee of the Cirencester Radio Society was responsible for a successful Radio Exhibition held recently in the Bingham Library, Cirencester. By means of this effort, which was well supported by local wireless enthusiasts, it is hoped that the membership of the Society will be considerably strengthened. Many amateur constructors showed quite a wide range of home-made apparatus and accessories, and a number of attractive trade stands contributed to the success of the event.

* * * *

On November 14th members of the Wimbledon Radio Society profited by an instructive talk on elementary principles, provided by Mr. C. E. P. Jones. A feature of the meeting was the projection of illustrations on the screen by means of a "Radioptican."

The society held a very successful whist drive and dance on Saturday, November 15th.

* * * *

An interesting "constructional" meeting was held by the Beckenham and District Radio Society on November 20th, the subject of discussion being an original type of coil holder specially designed for economy of space and cost. The demonstrator for the evening was Mr. A. West.

* * * *

The Lewisham and Catford Radio Society has prepared an attractive programme for the winter, and a special effort is being made to enrol new members. Much interest was recently provided by a lecture and demonstration dealing with an unusually sensitive "high tensionless" receiver.

* * * *

Morse practice is a regular feature at the meetings of the North Middlesex Wireless Club. Informal discussions are also held, and have recently covered such subjects as "Short Wave Reception," "Counterpoise Earths" and "An Unusual Crystal Receiver." Meetings of this kind serve to show the topics on which information is most desired, and the Committee are thus assisted in the compilation of programmes for the more formal lecture evenings.

A "gadget" night was recently held with great success by the Barnet and District Radio Society, several members exhibiting accessories of their own design. Special interest was shown in some transmitting gadgets produced by Mr. A. H. Gardner (**2 AHM**), a local transmitter. It is hoped to hold a similar evening in the near future.

* * * *

The winter programme of the Dulwich and District Wireless Society is now in full swing, and several instructive lectures and demonstrations have been given. Special enthusiasm has been shown in the morse classes, in connection with which a competition is being held at the end of the season. New members are required, and the hon. secretary will be pleased to answer all enquiries.

* * * *

The use of long and short waves in commercial wireless was the subject of a paper recently given before the Tynemouth Y.M.C.A. Radio Society by Mr. Sims. Whilst the efficiency of short waves was undoubted, the opinion expressed was that owing to their present impracticability during the hours of daylight long wave transmission was still the best for commercial work.

After the discussion on this paper, Mr. W. A. Matheson, Hon. Secretary of the Society, gave a short talk, with blackboard illustrations, on the "Theory of Electrical Generators."

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 3rd.

Institution of Electrical Engineers (Wireless Section). At 6 p.m. (Light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "Wireless Telegraphy Valve Transmitters employing Rectified A.C." By Mr. G. Shearing, B.Sc.

Radio Research Society, Peckham. At 44 Talfourd Road. Discussion: "The Effect of a Magnetic Field on the Working of Valves." Lecture: "Duplex Telephony."

Bristol and District Radio Society. Wireless Lecture No. 6. By Mr. W. A. Andrews, B.Sc.

Edinburgh and District Radio Society. At 8 p.m. At 117 George Street. Sixth General Meeting of Series.

Tottenham Wireless Society. Business Meeting.

THURSDAY, DECEMBER 4th.

Bournemouth and District Radio and Electrical Society. At 7 p.m. At Canford Hall, St. Peter's Road. Open Night. Experimental Work, etc.

Luton Wireless Society. At 8 p.m. At Hitchin Road Boys' School. Lecture by Mr. H. W. Pope (of S. G. Brown, Ltd.).

West London Wireless and Experimental Association. At Belmont Road Schools, Chiswick, W.4. Annual General Meeting.

FRIDAY, DECEMBER 5th.

Bristol and District Radio Society. Lecture: "Low Frequency Amplification." By Mr. L. Lott.

TUESDAY, DECEMBER 9th.

Radio Society of Highgate. At 8 p.m. At the Literary and Scientific Institute, South Grove. Lecture: "Continental Broadcasting." By Captain Plugge B.Sc.

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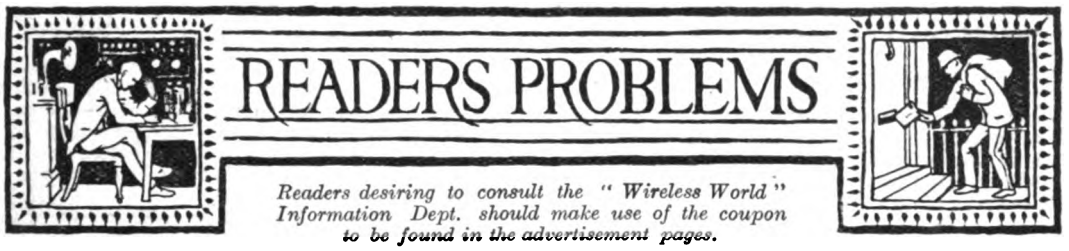

READERS PROBLEMS
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

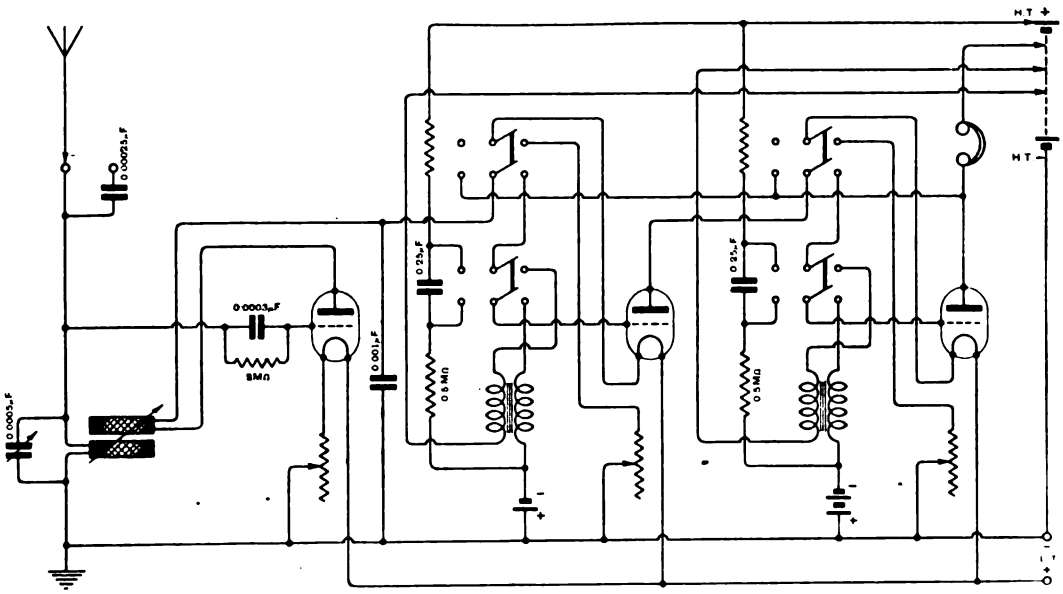
ALTERNATIVE COUPLINGS FOR L.F. VALVES.

IN the diagram given below, switches are provided so that the two L.F. valves may be coupled either by transformers or by the resistance-capacity method. Two D.P.D.T. switches are used for the valve, the upper switches being employed to control the number of valves in use, and the lower switches to change the method of coupling. It will be observed that the centre contacts of the latter switches are connected to the anodes and grids of the valves. The lower contacts connect the grids either to the secondary winding of the L.F. transformers, or to the 0·5 megohm grid leaks of the resistance coupling system. The upper contacts connect the anodes either to the primary windings of the transformers, or to the lower ends of the anode resistances. Whenever the circuit is changed, the H.T. tappings will have to be redistributed, in order that each valve may receive the correct anode potential. For this purpose wander plug connections on the battery should be used, as the use of switches to bring about the same results would be impracticable. If the receiver shows a tendency to self-oscillation at audio-frequency, large condensers may be connected between one or more of the + H.T. tappings, and the minus side of the H.T. battery.

AERIAL EFFICIENCY.

A READER has observed a gradual falling-off in the efficiency of his aerial system, which he attributes to corrosion of the surface of the aerial wire. He asks whether it would be any advantage to silver-plate the wire in order to preserve the surface conductivity.

Corrosion or blackening of the surface of the aerial wire is not likely to bring about any noticeable diminution in the efficiency of the aerial. Any slight losses which the corrosion may cause can be eliminated by the use of enamelled wire, which would be much less expensive than the process of silver-plating.



A three-valve receiver with alternative couplings for the L.F. valves.

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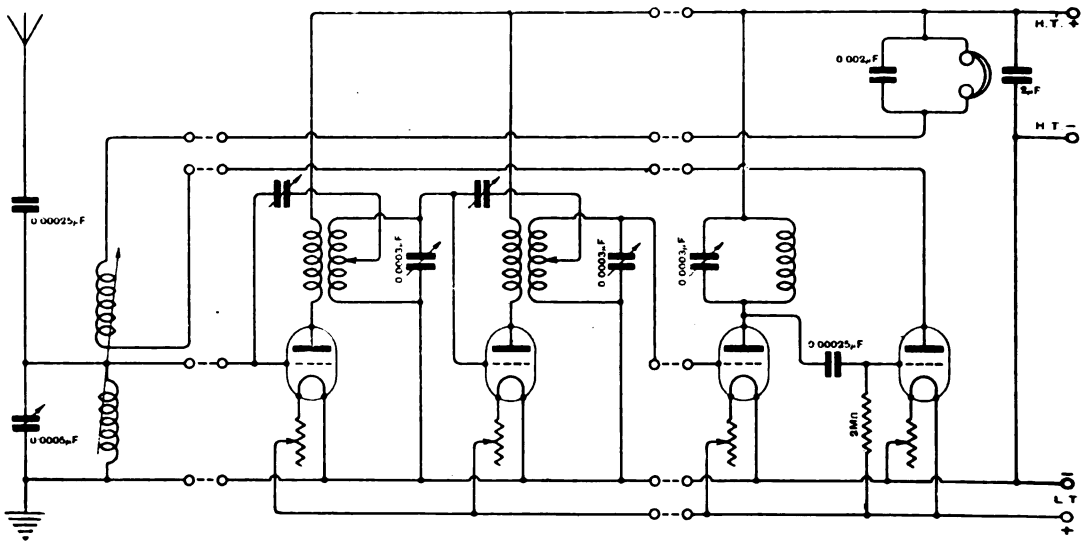
The inefficiency is more likely to be due to a film of dirt on the insulators, or faulty insulation in the lightning arrester or earthing switch. An examination of the earth connection should also be carried out to make sure that the earth wire is not broken at some point below the surface of the ground, and to ensure that the soil near the earthing plate is slightly moist. It is often an advantage to surround the earthing plate with coke in order to retain moisture, and to make efficient contact with the ground.

A NEUTRODYNE H.F. AMPLIFIER.

SEVERAL readers have asked for diagrams showing how to add one or more stages of H.F. amplification to their existing receivers, and accordingly a diagram is given below which shows how a two-valve H.F. amplifier coupled on the neutrodyne principle may be added to a two-valve receiver consisting of one H.F. and one



Adding a neutrodyne H.F. amplifier to a two-valve receiver.

detector valve. When two or more H.F. valves are employed, the neutrodyne method of coupling is the only one which gives really satisfactory results. In other methods of coupling, in which damping is introduced by means of resistances, or by causing grid current to flow, inefficiency is bound to occur, and the damping resistance also produces a marked decrease in selectivity.

Before adding the amplifier to the receiver, the tuning coils and condensers must be removed from the set and mounted in a separate unit. Terminals may then be fitted to the valve panel for the H.T. and L.T. connections, the grid connection to the first valve, and the reaction connections. Leads for the reaction coil may be extended across the two-valve panel, and since two stages are added, there will be no necessity to cross over the leads. If a single stage had been added, the leads would have had to be reversed, in order to bring the reaction currents into correct phase with the currents in the aerial circuit.

GRID BIAS FROM THE H.T. SUPPLY.

A METHOD of obtaining grid bias by connecting a resistance in series with the H.T. battery has been dealt with several times in this journal. A correspondent has asked for particulars of a resistance to obtain a suitable negative bias for two D.E.6 type valves when an H.T. voltage of 60 volts is employed.

Examination of the characteristic curves of the D.E.6 type valve shows that a negative grid bias of 3 volts is necessary when 60 volts H.T. is employed. Under these operating conditions the total anode current to both valves in the amplifier will be 3·5 milliamperes. The resistance necessary to give a potential of 3 volts when a current of 3·5 milliamperes is flowing is given by Ohm's law as 860 ohms.

As the same H.T. voltage is used for both valves, the same grid bias may be used in both cases, the grid return leads being connected to the end of the grid resistance connected to — H.T. A fixed condenser of 1 or 2 μF should be connected across the grid bias resistance to prevent coupling between the grid and anode circuits.

THE ALL-PURPOSE RECEIVER.

REFERRING to Fig. 3 on page 99 of the issue of October 22nd, a correspondent asks what value should be given to the condenser mounted below the H.T. and reaction terminals on the upper terminal strip.

This condenser is the telephone condenser connected across the centre contacts of the D.P.D.T. telephone and loud speaker switch. The value of this condenser will be seen from Fig. 1 to be 0·002 μF.

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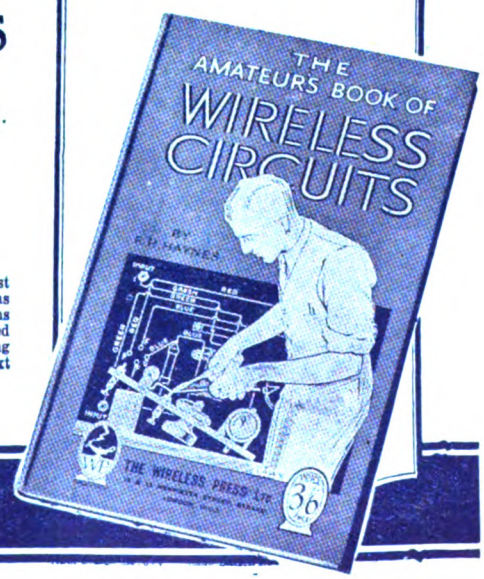

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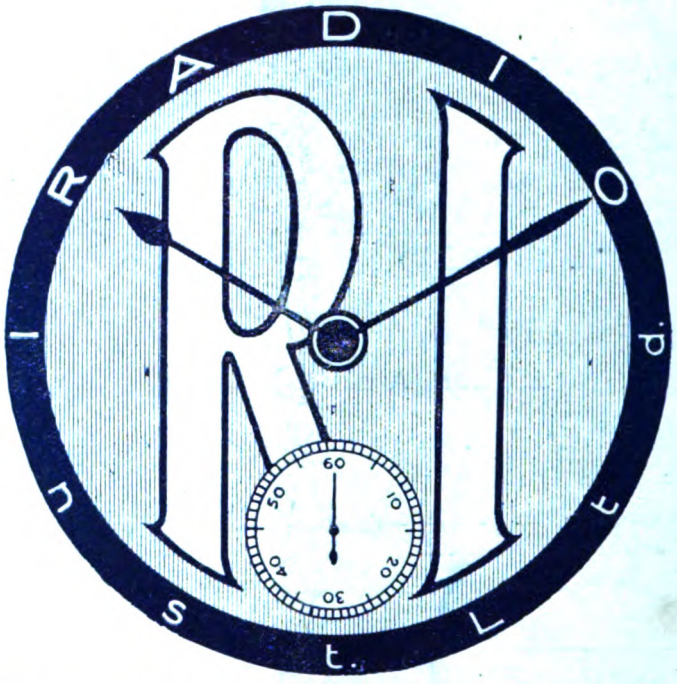

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

By THE EDITOR.

THE RESPONSIBILITY OF THE MANUFACTURERS.

INNUMERABLE wireless sets are being made up at the present time by amateur constructors, many of whom have comparatively little technical knowledge and would not be able to trace out any except the most obvious faults after the set had been constructed. Those who construct sets in this way are obliged to follow slavishly in every detail the instructions given in the journal or book from which they obtained the design. Unfortunately it happens not infrequently that although the design from which the set is built is accurate in every detail, and has been copied with equal accuracy, the set may yet refuse to work, due to no fault either of the designer or the constructor.

Every firm of repute undertakes to test complete sets before they are put on the market, but there does not appear to be the same caution exercised with regard to components.

Very obvious defects in apparatus, such, for instance, as variable condensers where the plates are found to touch at certain points, are not the cause of much distress amongst constructors for the reason that they are so obvious that no time is wasted in trying to detect the fault, but there are other types of faults which do not come within this category and may puzzle the most experienced experimenter for some time.

In the course of our experience, and referring only to apparatus by responsible manufacturers, we have met some peculiar defects in components—grid leaks which have come adrift inside and instead of giving their stated resistance value have gone up to a resistance of almost infinity; valves have not infrequently been met with where the plate and grid are touching, or the filament may be in contact with the grid; many other examples of faults might be cited but one of the most remarkable and disconcerting was experienced recently when, after a great deal of time had been spent with an experimental set which refused to operate, it was found that the grid battery supplied by a well-known maker had the poles marked incorrectly. Perhaps one of the most common causes of inefficient results from a set is the quality of ebonite or so-called ebonite, used for the panel. There is at present on the market a quantity of extremely inferior ebonite substitute material much of which is imported from abroad. The responsibility for the supply of reliable material does not rest only with the manufacturers in this country, but also with dealers and retailers who may market imported material of inferior quality.

BEACON STATIONS.

ONE of the post-war developments of wireless has been the perfection of what have come to be known as Beacon Stations for providing an additional aid to navigation. It may not be generally known that there are at present several beacon stations in operation around our coast, and although not much is heard of them, we believe that they are performing useful service. In this issue we publish an article discussing the problem of beacon stations by one who has been largely responsible for the development of this type of equipment since the war.

We hope that by the publication of such an account it will be possible for a better estimate to be made of the scope or limitations of the system as applied to the requirements of navigation.

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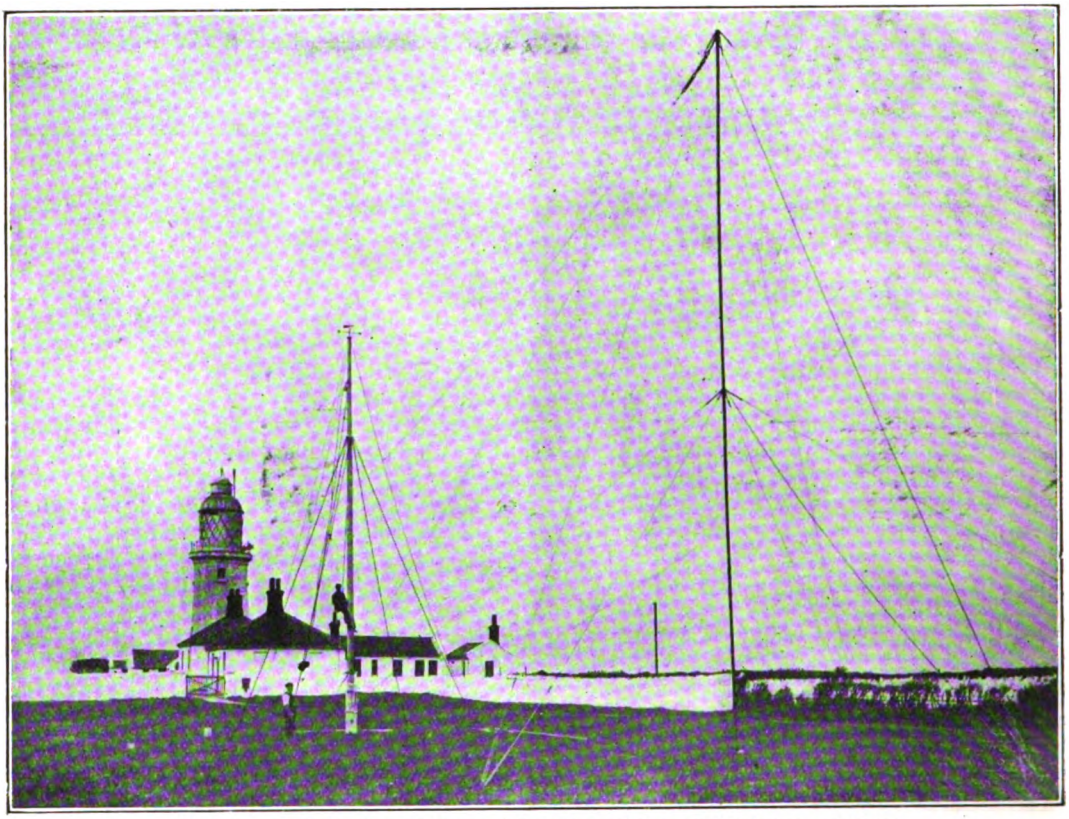

Fig. 1. *General view of the aerial of one of the coastal beacon stations.*

THE PROBLEM OF BEACON STATIONS.

The subject of the employment of beacon stations as an aid to navigation is one of very considerable interest. The author of this article, who has had a wide experience in the development of this branch of wireless, describes the purpose of the system, and discusses its advantages and limitations.

By COMMANDER J. A. SLEE, C.B.E., R.N. (Ret.), M.I.E.E.

A BEACON station is one whose primary duty is to aid in the navigation of ships by emitting wireless signals of such a character that vessels equipped with their own direction finders can obtain bearings of the beacon with a degree of accuracy sufficient for the purposes of maritime navigation. Some stress must be laid on the fact that the stations dealt with in this article are intended for marine and not for aerial navigation. The requirements of the two arts are similar in principle, but differ so widely in degree that they cannot be grouped together under an invariable or even under a general rule, although every opportunity must be taken to serve the two purposes with one station whenever it is practicable to do so.

As far as beacon stations are concerned the chief difference lies in the fact that navigators of ships are seldom in need of bearings of points of land at distances

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exceeding some fifty miles, whereas, due to the very high speed of aircraft and the comparative difficulty of fixing their position by other means, the requirements of aerial navigation demand bearings of fixed points at much greater distances. The marine navigator requires beacon stations of comparatively short range placed at salient points which themselves constitute dangers that must be avoided, while the aerial navigator requires beacons of long range placed at spots which he can approach in safety.

Beacons for marine purposes must often be placed in positions where the sea traffic is very dense, and such places are usually close to densely populated areas where other wireless services are very numerous, and therefore the requirement that the beacon service shall not interfere with and shall not be impeded by other services becomes very exacting.

In the present state of wireless communications there is room to fit in a marine beacon service on a wavelength of 1,000 metres, though the range of waves which can be made available is not large, and considerable precision of tuning is necessary.

Starting from the idea that the range of the typical marine beacon station will be about fifty miles, it becomes necessary to translate this measurement into some more tangible figure which can easily be verified. The main factor which determines the emission from a wireless transmitting station of ordinary type and working an any particular wavelength is arrived at by multiplying together the aerial current and the radiation height of the aerial. This latter figure is some proportion of its maximum height, and for all forms of aerial likely to be used for beacon purposes this proportion will probably lie between 0·5 and 0·7. It is therefore reasonable to make an arbitrary assessment of the emission in terms of the product of aerial current and maximum height, and if this product is called the " metre-amps " of the station it may be stated with sufficient accuracy that reliable bearings can be obtained by a modern marine direction finder at a distance of about 1½ miles per metre amp. Thus 35 metre-amps is sufficient for a working range of 50 miles, and experiment has shown that emission at the rate of 35 metre-amps on a wave of 1,000 metres produces a negligible amount of interference with other wireless services existing at the present day.

In order that this satisfactory state of affairs can exist it is, of course, necessary that the transmitted wave shall be of a high degree of purity. The qualifications of a pure wave are that harmonics of its fundamental frequency shall be as feeble as possible, and the Fourier theorem clearly shows that this necessitates the slowest possible rate of growth and decay in the amplitude of the transmitted wave. This requirement can only be completely met by the use of an unbroken long dash of continuous wave emission, but experience shows that this method is inadmissible on two grounds. The worst trouble is that bearings obtained of continuous wave transmitters are unreliable during the hours of darkness, variations of observed bearing up to and even exceeding 10 deg. being quite common. A theoretical discussion of the causes of this " wandering " is out of place here, but the matter has been explored in Mr. Keen's book on " Direction and Position Finding by Wireless," and in the discussion on the author's paper read before the Institute of Electrical Engineers and published in the journal of that institution for June, 1924.

The unbroken long dash, however it may be produced, is unsuitable as a form of beacon signal because of the difficulty of identifying the station of origin. The use of continuous wave being thus ruled out, the next best method must be sought. This must be either some form of modulated continuous wave or a carefully selected type of spark transmission.

It is a well-established fact that bearings obtained from spark transmitters are almost immune from wandering, except during a period of about half-an-hour, embracing the time of sunset and sunrise, and during these periods the band of zero signal strength, whose position determines the direction, becomes ill defined. This gives the observer warning that bearings are temporarily unreliable. Careful investigation has shown that fully interrupted continuous wave is an equally reliable form of radiation, and as an interrupted continuous wave is more free from interfering subsidiary emissions of all kinds, and as there is no doubt about the availability of completely reliable apparatus, the choice of transmitter for beacon purposes in crowded areas lies with the interrupted continuous wave system. In order to ensure

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the degree of reliability of bearings necessary for marine navigation, the interruptions must be such that the emission is reduced to zero between the wave-trains.

Experiments show that the proportion between metre-amps and range for interrupted continuous wave transmitters working to modern direction finders is the same as for spark transmitters. It is worthy of note that this figure must be obtained under conditions of accurate direction finding. If the amplifier in use is allowed to reach, or even to approach very closely, to a state of interrupted continuous wave than for spark transmission in the proportion of at least two to one.

The site of a beacon station for marine purposes must be chosen with care. It must be placed so that over all the area it is intended to serve no high land shall obtrude between the beacon and the ship making use of it. This requirement can as a rule be met if beacon stations are established at lightships or at lighthouses. If this condition is not fulfilled bearings observed in the arcs covered by what may be called the shadow

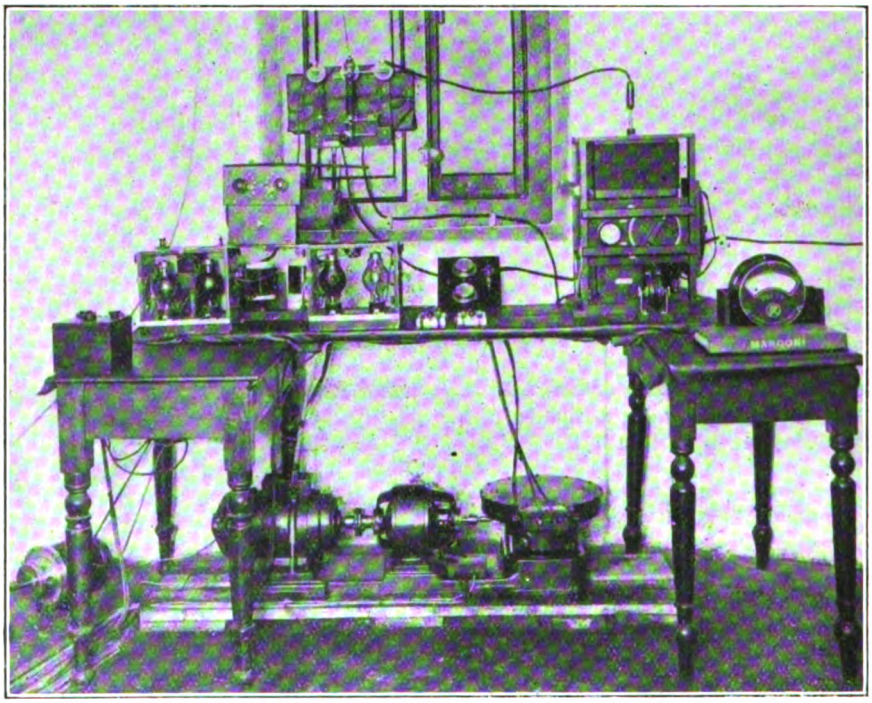

Fig. 2. Spark and C.W. transmitters.

self-oscillation, the bearings observed will be quite unreliable, and this limitation must be strictly adhered to. Interrupted continuous wave is well known to be a highly efficient form of transmission if the receiving amplifier can be worked at or close to the state of self-oscillation, but under direction finding conditions, when this state must be avoided at all costs, no remarkable efficiency of transmission can be expected. With an absolutely non-oscillating and non-integrating receiver, such as a plain crystal, the proportion of metre-amps to miles is higher for of the obstruction will be erratic. This trouble is one of the chief causes of the inadequacy for the purposes of navigation of the existing wireless stations used for communication with ships. A glance at the " arcs of good bearings " shown in Fig. 3 will make this point clear.

Turning to the form of signal to be transmitted by the beacon, the first requirement is that it shall be possible for ships within range of it to obtain a bearing about once in five minutes, and a duration of transmission of about one minute is sufficient to enable

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a skilled observer to obtain a series of four or five bearings. At a few outlying stations ranges greater than 50 miles may be desirable, and such more powerful beacons might be limited to one period of transmission in 8 or perhaps 10 minutes.

The nature of the signals transmitted must be such that bearings are easy to observe and also such that it is easy to identify the beacon station.

Only protracted trial can show what form of signal is preferred by the majority of observers, but the most promising form seems to be the steady repetition at a fair telegraphic speed of a group of three or four letters forming the identification signal of the beacon. The alternative method is to transmit a few repetitions of the identification signal at the beginning, middle, and end of the period of transmission, linked together by prolonged dashes, or by a regular series of dots and dashes.

In order to get an ideal fix, bearings of three beacons should be obtainable in rapid sequence, though in practice two such bearings are of very great value, and the necessity for covering the more important parts of the narrow seas with the emissions from two or more beacons introduces a fresh complication. The actual operation of all current types of direction finders takes the form of determining the position of some sort of frame when it is receiving zero signals from the beacon under observation. The position of zero reception by a frame occurs when it lies in a plane at right angles to the plane of direction of the source of origin of the signal, and the position of maximum reception by a frame occurs when it lies in the same plane as the source of origin, the former position being sharply defined and the latter being very broad. Hence, if the instrument is in a position to determine the bearing of any one beacon it will at the same time be receiving maximum signals from any other beacon that may happen to lie at or anywhere nearly at right angles to the bearing of the station under observation.

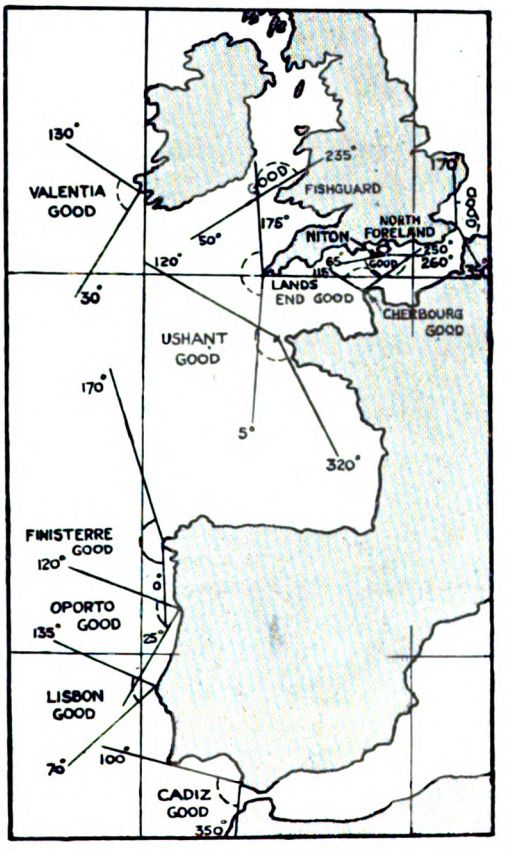

Fig. 3. Arcs of good bearings.

If the times of transmission of two neighbouring beacons coincide, the observation of bearings becomes difficult to an unpractised ear, although a skilled telegraphist is capable of taking accurate bearings under such circumstances.

Since it is impossible to synchronise all beacons without most elaborate and costly apparatus, the next best thing is to run neighbouring beacons definitely out of step with one another, making the "one minute" unit of transmission only nominal, but maintaining the intervals of silence at four times of the length of the period of transmission.

If the actual timing of one beacon is 65 secs. transmission and 4 mins. 20 secs. silence, and that of the next beacon 55 secs. transmission and 3 mins. 40 secs. silence, complete clashing of the two is impossible, and they will only interfere seriously with one another three times in each hour.

The characteristic musical note of the signal is governed by the frequency of the motor-alternator supplying the transmitter with power, and if standard alternators are used for all beacons the variation in timing

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just described can be achieved by running the machines at different speeds. This will impart quite distinct notes to the various signals, and will greatly facilitate the task of picking out the signals of one beacon from those of another. If beacons are worked on this system, there is nothing to be gained by attempting accurate timing.

It would, of course, be of advantage if neighbouring beacons could make use of distinctly different waves, but it is clear from the above that the service can be carried out with one wave, and the congestion of modern wireless traffic makes it much easier to allot one wave for this purpose than to find two.

As the typical beacon station can be expected to have a working range of 50 miles, and as it is impossible for a man in charge of a beacon to know what the weather is like 50 miles to seaward, the only practicable plan is to keep the beacons always working. A satisfactory system of communication whereby ships requiring the use of beacons could ask for them to be started implies the use of so large a staff as to be economically impossible. The necessity for beacon stations is not always due to fog alone. A prolonged spell of cloudy weather may have deprived shipping of astronomical observations for some days before approaching the land, and in such cases one or more direction finder bearings are of the greatest use in making a landfall.

The apparatus required to produce an emission of 35 metre-amps is quite simple. The power that must be supplied to the aerial is not likely to exceed 100 watts even under most adverse conditions, and the direct current power required for all purposes should not exceed 400 watts when the beacon is transmitting, and about half this amount during the periods of silence.

The photographs show the prime mover, transmitters and aerial, employed during experiments just concluded at the lighthouse at Nash Point, in the Bristol Channel, which has been made available by Trinity House for the long series of experiments which have been necessary to clear up the various points explained in this article.

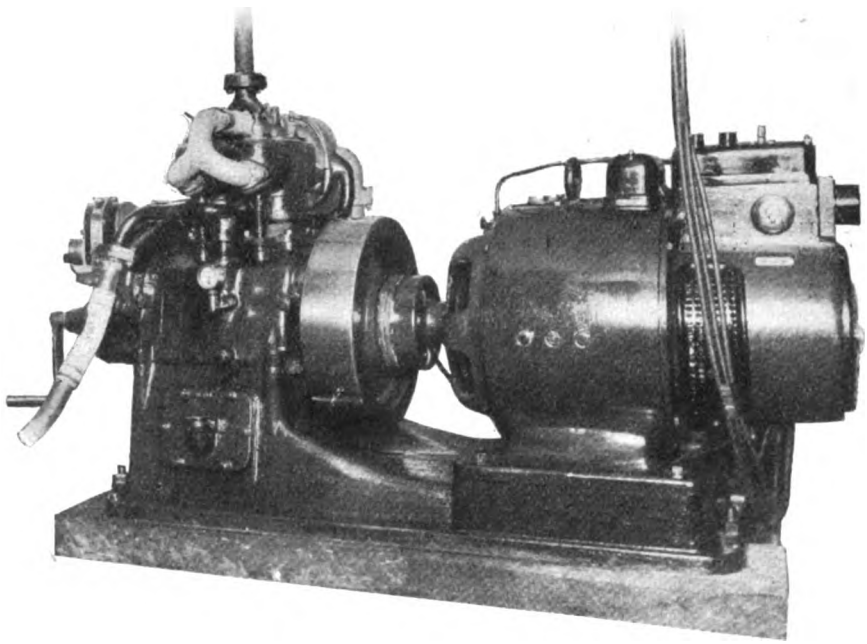

Fig. 4. The Austin automatic power plant.

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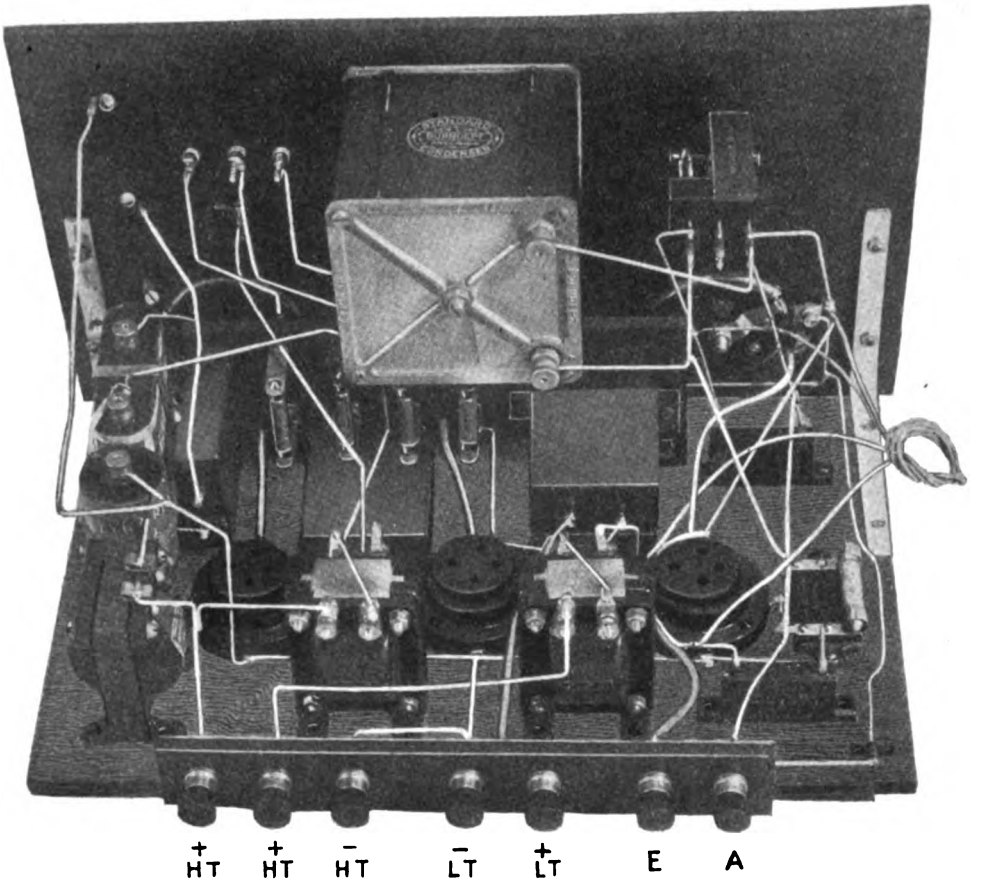

A back view of the receiver showing the arrangement of the components.

IDEAL RECEIVERS—I.

A THREE-VALVE RECEIVER

With Valve Detector and Two Stages of Choke Coupled L.F. Amplification.

By W. JAMES.

(*Concluded from December 3rd issue*).

IN the first portion of this article we pointed out that it is desirable to employ valves having a high amplification factor and chokes of large inductance in order that the largest possible voltages shall be applied to the grid of the last valve. If the inductances connected in the anode circuits have too low a value, there will be distortion, and the voltage amplification will be less than it need be. The minimum value for the inductances depends on the lowest frequency in the signal to be amplified and the impedance of the valves. With valves of the D.E.5B. type, chokes having an inductance of about 100 henries are suitable.

It is as well to mention again that the last valve must be of the power type. The last valve supplies the current which

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operates the loud speaker. Therefore it must be one which has ample emission, and a low impedance. The valve recommended is one of the D.E.5 class.

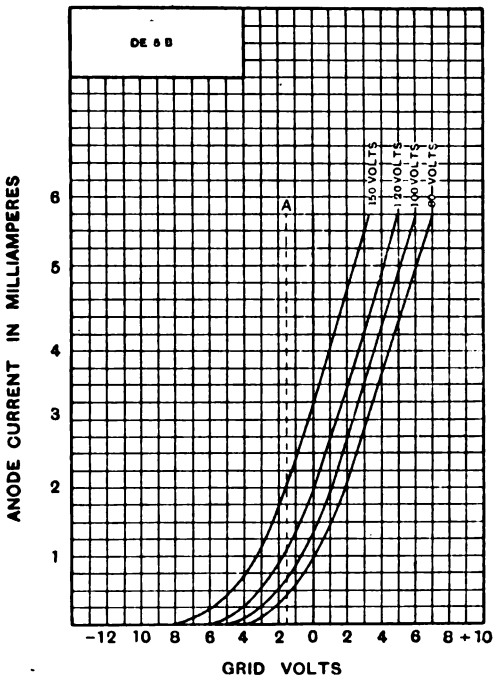

Fig. 1. Characteristic curves of D.E. 5 B valve.

There is one other very important thing which we feel should be emphasised, and that is the grid bias. If grid current flows in amplifier circuits there is sure to be distortion. We suggested that a signal of 5 (peak value) volts, or a total grid voltage swing of 10 volts applied to the grid of the last valve would be ample for the usual household loud speaker. Therefore the grid of the last valve is given a bias of about negative 6 volts, obtained from 4 dry cells. As we expect the second valve to amplify the signal 18 times, the grid bias of the second valve need only be small. A single dry cell is used.

We have now ensured that there will be no grid current distortion, provided the signal voltage applied to the last valve does not exceed 5 volts, and we know that because the valves and couplings are matched, *they* will not introduce distortion.

We have still to determine the anode voltages. From the curves of a D.E.5B. valve, Fig. 1, we see that when the grid is 1½ volts negative, an anode voltage of about 120 is suitable. The normal anode current is about 1 milliampere. To this voltage should be added the voltage drop due to the resistance of the choke which, however, is so small as to be negligible.

For the last valve, a D.E.5, we find from the characteristic curves of Fig. 2 that with a grid bias of 6 volts an anode voltage of 120 volts is suitable, and that the normal anode current is about 6 milliamperes. The second and third valves are therefore given the same value of H.T., and a common terminal is employed in the receiver. For the detector valve a separate H.T. terminal is provided, as it is desirable to adjust the anode voltage of this valve to secure best detector action and smooth reaction effects.

The receiver was designed on the assumption that a signal voltage of 5 volts would

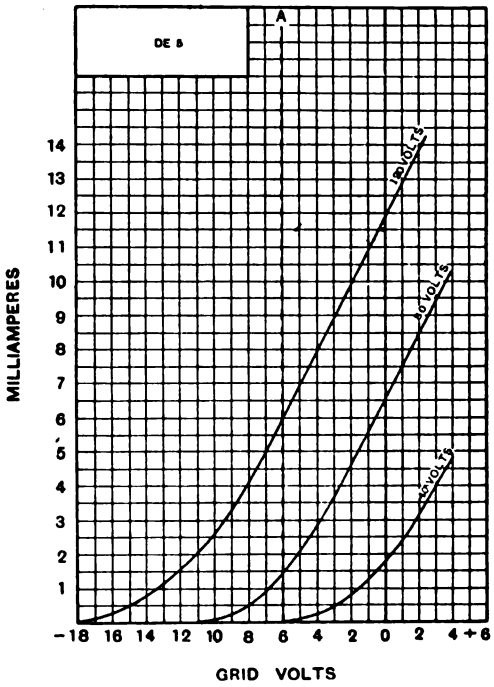

Fig. 2. Characteristic curves of D.E. 5 valve.

produce a satisfactory volume of sound from the loud speaker. When a large type of loud speaker is used, a signal voltage up to 8-10 volts may be required for the grid of the last valve. It would then be necessary to use a grid bias of about 10-12 volts, and

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if a D.E.5 valve is used, a higher anode voltage. We do not recommend employing an anode voltage of over about 120 volts with valves of this type, as they are designed for a maximum anode voltage of 120.

THE CONSTRUCTION OF THE RECEIVER.

The accompanying drawings and photographs show the position of the parts and the wiring. It will be seen that a front ebonite panel measuring 14 ins. by 8 ins. by ¼ in. carries a 0·001 μF tuning condenser,

To the bottom of the panel is secured by means of a pair of 4 in. brackets a base of wood, measuring 13¼ ins. by 8½ ins. by ⅜ ins. This base carries the valve holders, chokes, (two transformers are employed as chokes by connecting their windings in series), fixed condensers C_1, C_3 and C_4, and the grid battery which comprises a 4½ volt unit and a single cell.

The coupling condensers C_5 and C_6, the filter condenser C_7, the H.T. condenser C_8, and the grid leaks R_2, R_3, R_4 and R_5 are

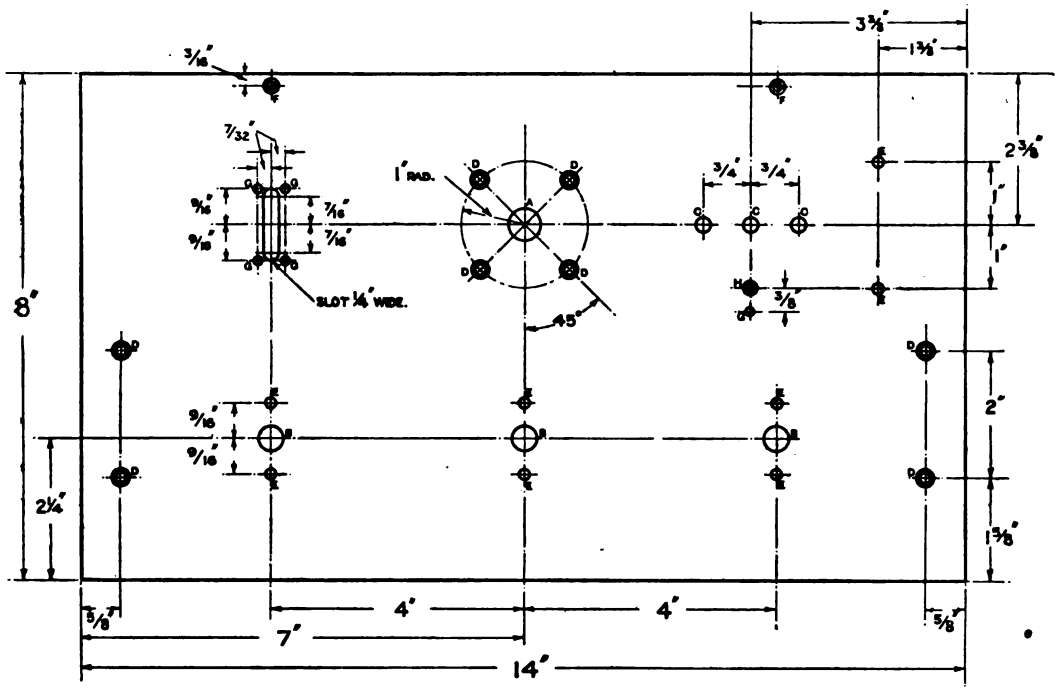

Fig. 3. Showing the position of the parts on the front panel. Drilling details are as follows—

A = Drill ¼ in. diameter.
B = Drill, ⅜ in. diameter.
C = Drill, 7/32 in. diameter.
D = Drill 5/32 in. diameter, and countersink on top side.
E = Drill 3/32 in. diameter.
F = Drill ⅛ in. diameter, and countersink on top side for No. 4 wood screws.
G = Drill ¼ in. diameter.
H = Drill ⅛ in. diameter, and countersink for No. 6 B.A. wood screws.

a series-parallel switch (double pole two-position), three *Clix* sockets and one plug, three filament resistances, and two terminals for the loud speaker. As the *Clix* sockets are connected to a grid circuit, special care should be taken that the ebonite is of good quality. The skin should be carefully removed. A two-coil holder is secured to the side of the containing box, as may be seen from the illustration at the head of the first portion of this article. The position of these parts is clearly shown in Fig. 3.

mounted on a piece of ebonite measuring 8 ins. by 3⅜ ins. by ¼ in., which is screwed to the base on the side nearest the panel. The arrangement of the parts on the base is given in Fig. 4, and Fig. 5A gives the details of the small ebonite strip.

The values of the parts are given below the wiring diagram, Fig. 6.

On the back edge of the base is fitted a strip of ebonite measuring 9 ins. by 1½ ins. by ¼ in., which carries terminals for the aerial, earth, L.T. and H.T. batteries. The position

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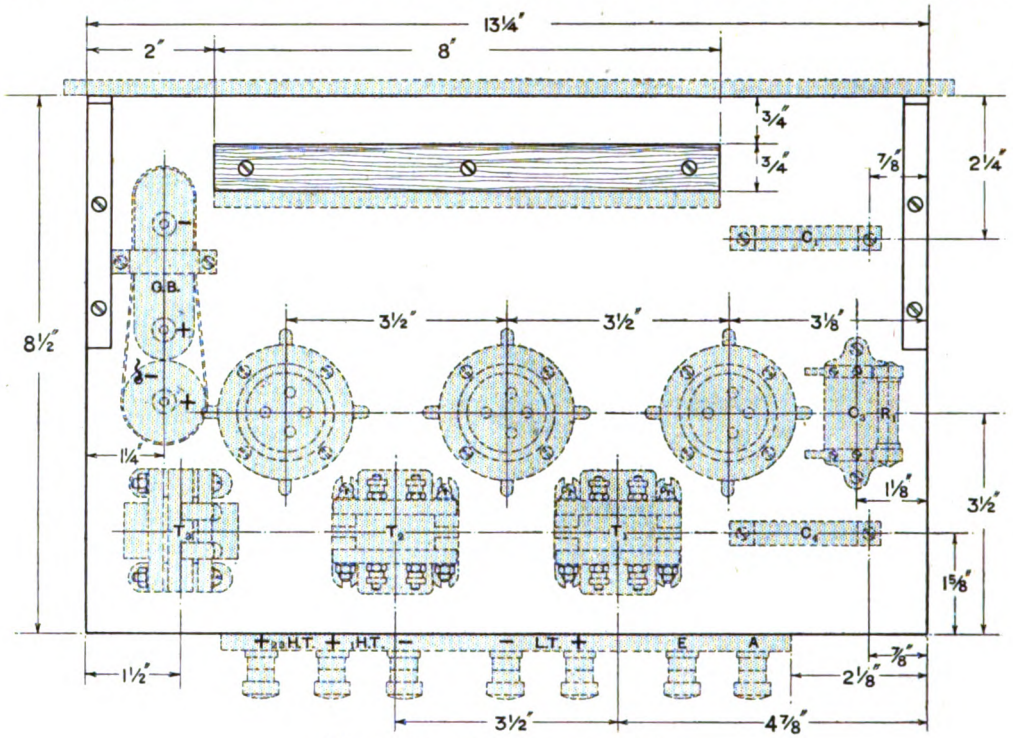

Fig. 4. Layout of components on base.

of the terminals is indicated in Fig. 5B. Having assembled the components according to the particulars given on the figures, examine the wiring diagram of Fig. 6. Notice that the wires connecting the filament resistances to the valves pass through holes in the small panel carrying the coupling condensers and grid leaks, and that this panel must be removed before the filament resistances can be wired. It is also convenient to remove the chokes.

Before commencing the wiring, clean and tin each part that is to be soldered. Commence the work by wiring the filament resistances, and the aerial circuit, using No. 16 tinned copper wire. Then wire the filament connections of the valves and the grid condenser (C_3).

The *Clix* plug is connected by a flexible wire to the No. 6 B.A. screw fixed below the sockets.

Now replace the panel carrying the coupling condensers and the grid leaks, and wire them according to the diagram.

Finally, replace and wire the chokes. The wires connecting to the + H.T. terminals are covered with sistoflex.

It will be found that if the work is carried out carefully and without haste, the connecting wires are short and easily arranged.

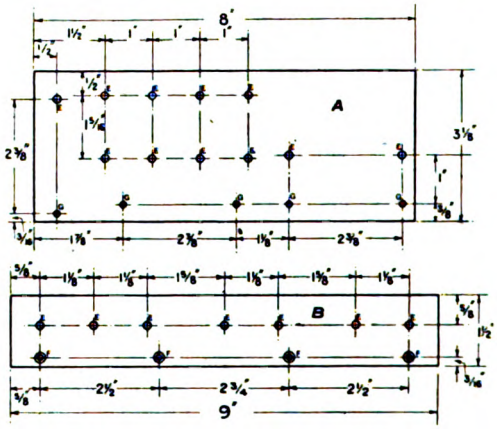

Fig. 5.

A = Details of ebonite strip carrying coupling condensers and grid leaks.
B = Details of ebonite strip carrying terminals for aerial, earth, L.T. and H.T. batteries.

Drilling Details.

E = 5/32 in. diameter.
F = 1/8 in. diameter, and countersunk for No. 4 wood screws.
G = 1/8 in. diameter.

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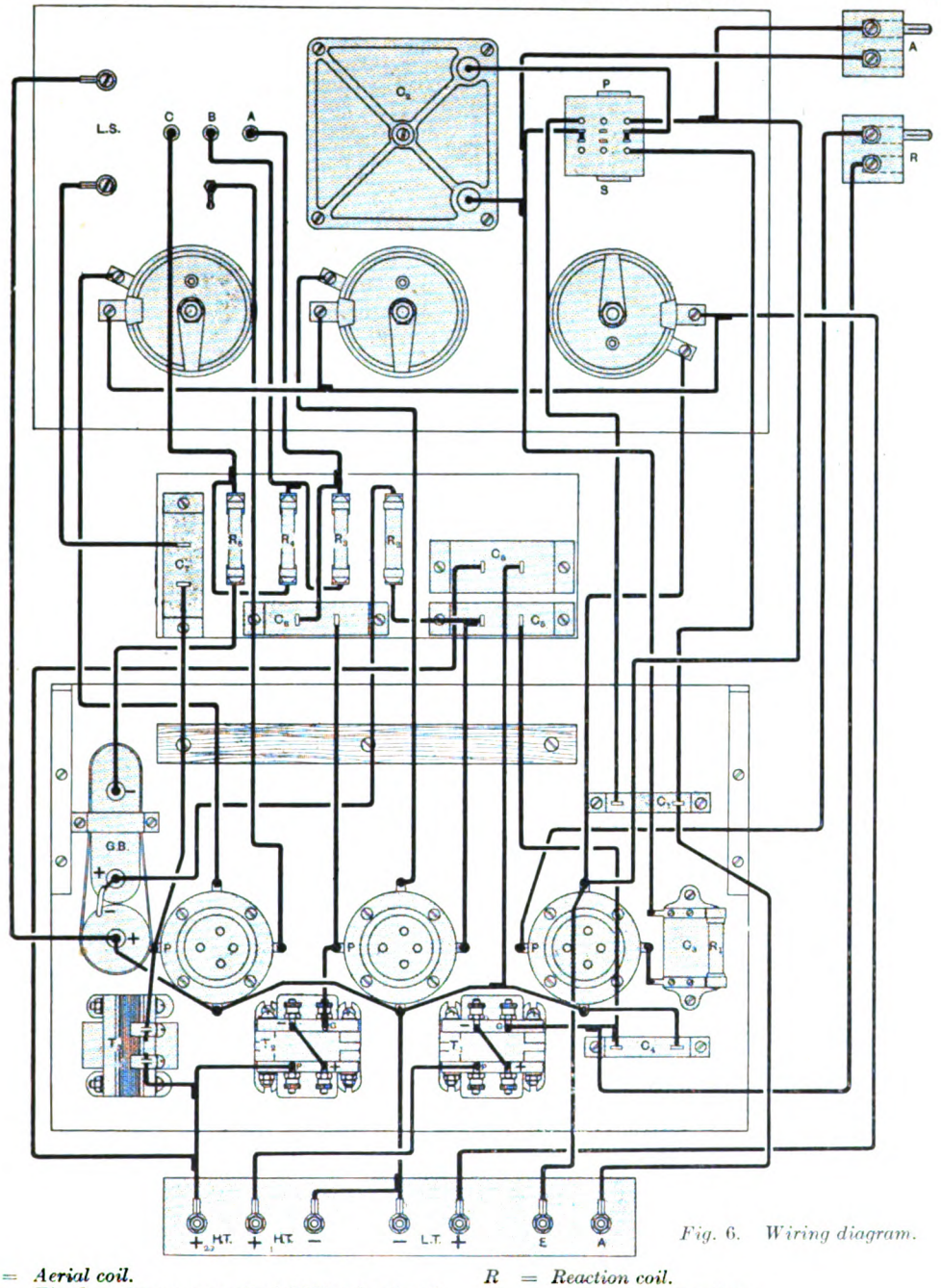

Fig. 6. Wiring diagram.

A = *Aerial coil.*
C_1 = *Fixed condenser, capacity 0·0002 microfarad.*
C_2 = *Aerial tuning condenser, capacity 0·001 microfarad.*
C_3 = *Grid condenser, capacity 0·00025 microfarad.*
C_4 = *Fixed condenser, capacity 0·0002 microfarad.*
C_5 C_6 = *Fixed condenser, capacity 0·125 microfarad (Mansbridge type).*
C_7 = *Fixed condenser, capacity 0·5 microfarad (Mansbridge type).*
C_8 = *Fixed condenser, capacity 2 microfarads (Mansbridge type).*

R = *Reaction coil.*
R_1 = *Grid leak, 2 megohms.*
R_2 = *Grid leak, 0·3 megohms.*
R_3, R_4, R_5 = *Grid leak 0·1 megohms.*
T_1 T_2 = *Burndept low ratio transformer with windings connected in series.*
T_3 = *Burndept 20 henry choke.*

The series-parallel switch is a Burndept double-pole change-over key switch (the one used in the instrument described has an extra set of contacts which are not required).

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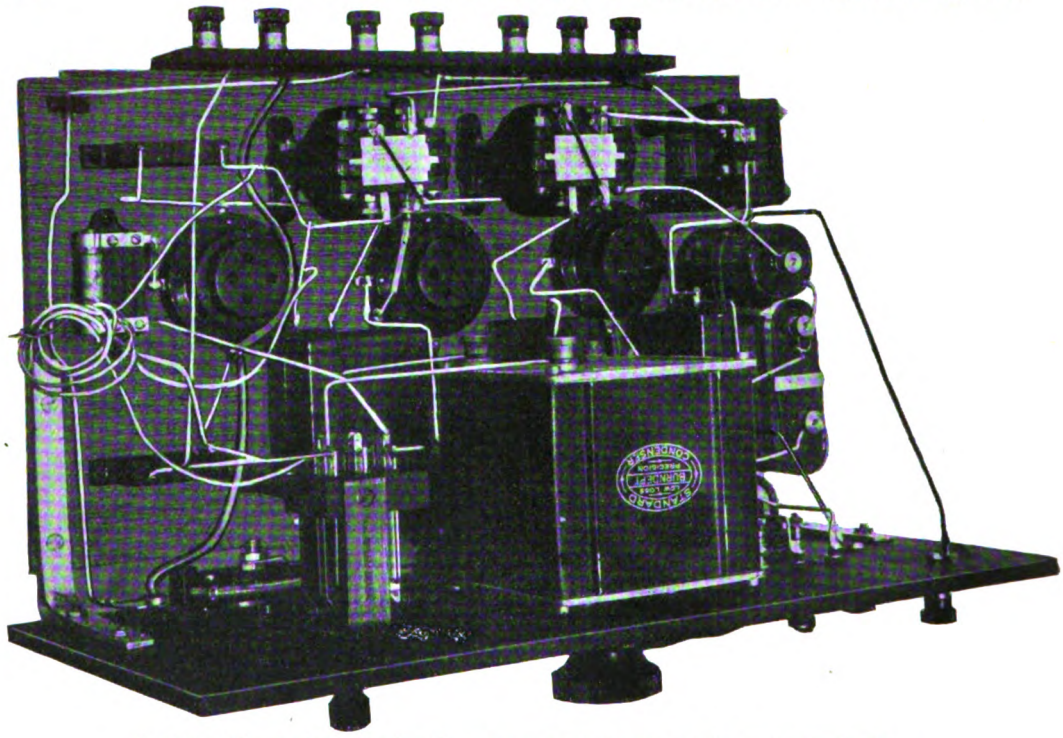

A view of the receiver showing the arrangement of components on the baseboard.

Four rubber-covered flexible wires are connected for the aerial and reaction coils. Their ends are passed through holes in the side of the containing case, and joined to the terminals on the two-coil holder. The correct connections are given in the wiring diagram, where A is the aerial coil and R the reaction coil.

A view of the containing box, with its dimensions appears as Fig. 7. The wood used is $\frac{3}{8}$ in. thick. The position of the two-coil holder on the side of the box is clearly shown. It will be observed that a piece is cut out of the back of the box to allow the connection strip to fit.

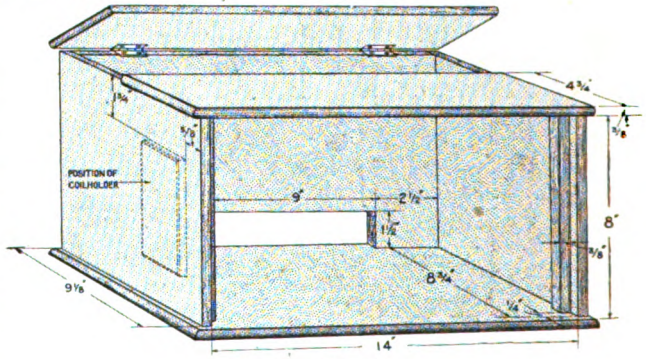

Fig. 7. The box.

OPERATION.

To receive the short wavelength broadcast transmissions fit a No. 35 or 50 coil in the aerial plug of the two-coil holder and a No. 35 coil in the reaction plug. Put the series-parallel switch in the parallel position. For the 1,600 metres station a No. 150 coil may be used in the aerial circuit and a No. 75 in the reaction.

When the signals are of good strength it will probably be found that best results are obtained by fitting the plug in the centre *Clix* socket. The volume will then be about two-thirds of the maximum.

It might be found that the signals are weakened by bringing the reaction and aerial coils nearer together. The connections to either the reaction or aerial coils should then be reversed.

It is essential to employ an anode voltage of the value given if distortion is to be avoided. The voltage applied to the detector should be varied until best results are obtained. We found a voltage of about 90 volts satisfactory.

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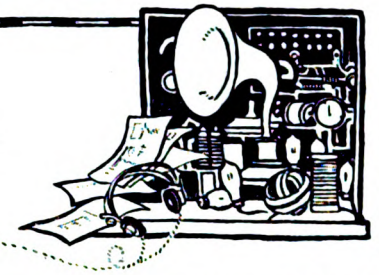
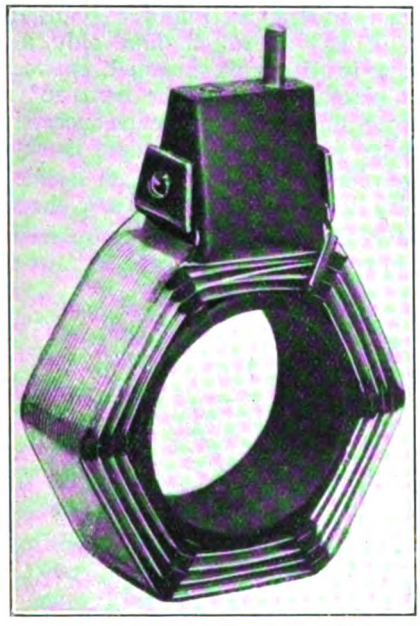
NEW APPLIANCES.



The New "Airmax" Inductance Coil.

One aim in inductance coil design is of course to bring the self-capacity of the winding down to as low a value as possible and the merit of a coil can to some extent be judged by the relationship of the value of self-capacity to the inductance. The self-capacity of a coil may be reduced by arranging the turns to be as far as possible air spaced, which brings with it the additional advantage of using air as a dielectric between the turns because of the very low dielectric loss which is produced. It is not a difficult matter to design coils with air spaced turns and possessing extremely low self-capacity, but difficulties arise when it is a requirement of the design that the inductance coils shall be interchangeable. Interchangeability is an ordinary feature as it renders the tuner operative over the entire band of wavelengths. The accompanying illustration shows a type of coil recently introduced which is secured to the customary two-pin mount. A piece of ebonite tube is used as a central former and six small pieces of insulating material are arranged to space the turns away from its surface. The coil is wound with bare wire and the necessary insulation between the turns is produced by spacing. Successive layers are separated by small pieces of insulating material, while the finishing end is terminated by soldering across on to a previous turn.

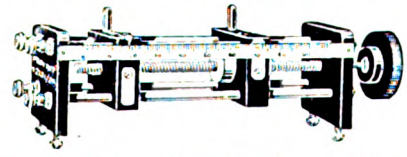


The new "Airmax" interchangeable inductance coil.

Sharpness of tuning is a property which may be observed and a coil having low self-capacity gives sharper tuning than one in which appreciable capacity exists between the turns when shunted with a valve grid filament circuit used as a detector. The low capacity coil also gives greater signal strength. Such a simple test may be applied to this coil and the experimenter will see for himself the advantages to be gained by adopting coils wound in this manner.

Two-Coil Holder

A critical degree of coupling is obtained when two inductances are made to slide one away from the other, and at the same time remain parallel. A useful form of two-coil holder is shown in Fig. 3, in which the coil mounts are carried on a spindle having differential screw threads. Thus as the spindle is revolved the two holders are propelled one away from the other. An ivory scale and pointer indicates the setting.



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THE "SQUARE LAW" CONDENSER.

In this article the author explains why condensers of the "square law" type have vanes which are different in shape to those of the ordinary tuning condenser. He also gives a method of setting out one type of square-law vane, and shows how to find its area for the purpose of estimating the capacity.

By J. AISBITT, B.Sc.

THIS note is an attempt to explain the object of the square law condenser and the peculiar shape of its vanes. The reader probably knows that the wavelength to which his set is tuned is proportional to the square root of the product of the inductance and the capacity in the tuned circuit, or, briefly,

$$\lambda = 1885 \sqrt{LC}.$$

It follows that if he turns the condenser dial—using the semicircular vanes—he makes a definite increase in wavelength for the first 10°, but on turning it from 0° to 20° he does not produce twice this increase. To effect this he must give a rotation four times as great; *i.e.*, from 0° to 40°, while thrice the increase requires nine times the rotation; *i.e.*, to 90°.

readings is impossible, without a vernier condenser, but how can this be remedied?

If that part of the moving vane which first enters between the fixed vanes is cut away somewhat, then a larger turn of the dial is needed to produce a given change in capacity.

It can be seen on examining Fig. 1, which represents an improved vane, that a turn of 10° makes at first only a small change in the area inserted between the fixed plates, but that the next 10° makes a larger difference, while each successive 10° produces a still larger increase in capacity.

Now let us see how we can decide more exactly how to produce this new shape.

Since the wavelength is proportional to the square root of the capacity, to double

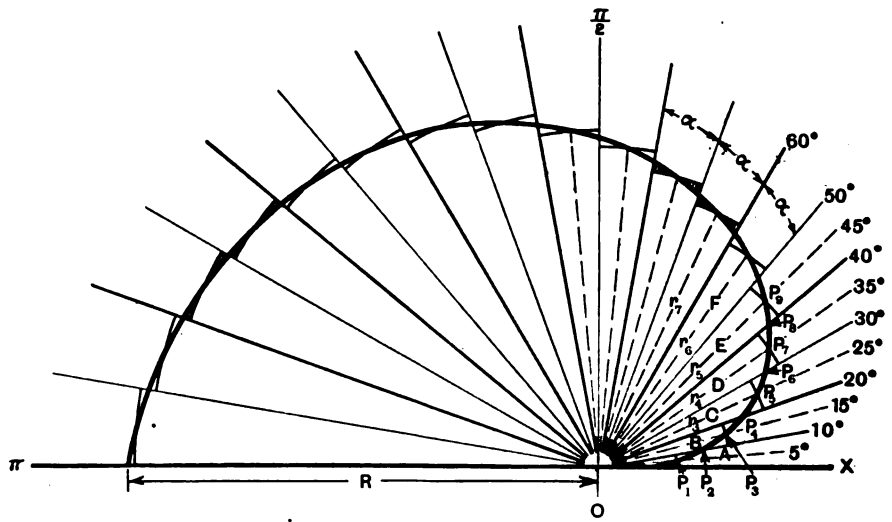

Fig. 1. Explaining the unusual shape of one type of "square law" condenser vane.

This explains why, in the ordinary variable condenser, the settings for stations on the lower part of the scale are crowded together while on the higher readings they are widely spaced.

Obviously, fine tuning on the lower

the change in wavelength we must quadruple the change in capacity, while to treble the change in wavelength we must effect a capacity change nine times as great as that produced by the first rotation of 10°, and so on.

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This means that if the area of the first sector, A (Fig. 1), including 10°, is represented by 1, then the area of the sector $(A+B)$, including 20°, must be 4, while the area of sector $(A+B+C)$ is 9, and so on.

That is, the areas of the sectors—

A, B, C, D, E, F — — — — — —

must be in the ratio—

1, 3, 5, 7, 9, 11 — — — — — —

But since the area of a sector of a circle is proportional to the square on its radius, then the squares—

$r_1^2, r_2^2, r_3^2, r_4^2, r_5^2, r_6^2$ — — — —

must be in the ratio—

1, 3, 5, 7, 9, 11, — — — —

while the radii are in the ratio—

$\sqrt{1}, \sqrt{3}, \sqrt{5}, \sqrt{7}, \sqrt{9}, \sqrt{11}$, — — — —

Now in Fig. 1 are shown sectors of circles, each sector including 10° at the centre, with 20°, 30°, etc., $OP = 0$, $OP_2 = \sqrt{2}$, $OP_4 = \sqrt{4}$, $OP_6 = \sqrt{6}$, etc., so the final method of construction arrived at is to draw radiating lines at any suitable angle—not necessarily 5°, and along them to set off lengths equal to 0, $\sqrt{1}$, $\sqrt{2}$, $\sqrt{3}$, $\sqrt{4}$, $\sqrt{6}$, $\sqrt{7}$, etc., etc., and joining them by a curve, as indicated in Fig. 2.

CALCULATION OF CAPACITY.

Since, in calculating the capacity of a variable condenser one must know the area of the plates, we must now find out how to calculate the area of this "square law" vane.

First of all, remember that the area of a circle is given by πr^2, while the angle at its centre is 360° or 2π radians. That of a semi-

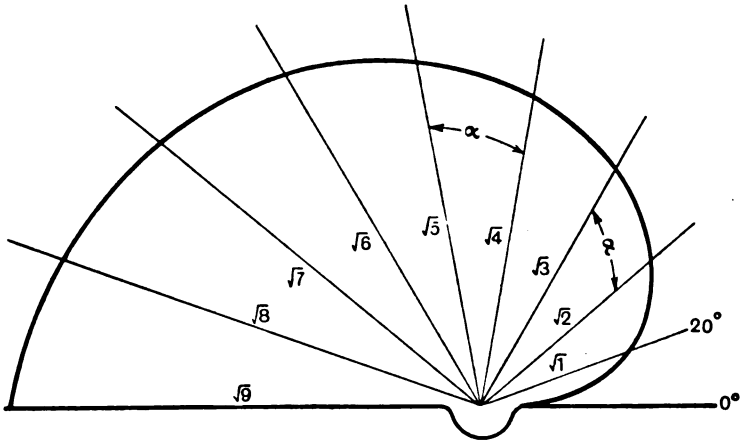

Fig. 2. The method of setting out a "square law" vane.

radii in this ratio, and it is apparent that if they were made exceedingly thin, to include 1°, say, instead of 10°, then their areas would merge into the resultant curve known as the "square law" curve.

One method of obtaining the required shape is to draw lines radiating from a point O and inclined to a line OX at 5°, 15°, 25°, 35°, 45°, etc., since these are the angles at which the radii are given in Fig. 1.

Then mark off $OP_1 = \sqrt{1}$ cms. or ins., $OP_3 = \sqrt{3}$, $OP_5 = \sqrt{5}$, $OP_7 = \sqrt{7}$ and so on.

On joining these points to form a curve, it will be found that at the angles 0°, 10°, circle, whose angle is π radians, is $\frac{\pi}{2}r^2$. Similarly, the area of a sector of a circle including an angle of α radians must be $\frac{\alpha}{2}r^2$. That is to say, we multiply the square on the radius by half the angle in radian measure*

Now we have seen that the vane may be considered as being made up of a large number of tiny sectors whose radii are in

* A radian is the angle subtended at the centre of a circle by an arc equal in length to the radius, and is approximately 57·3°.

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the ratio 0, $\sqrt{1}$, $\sqrt{2}$, $\sqrt{3}$, $\sqrt{4}$, $\sqrt{5}$ — — — R, where R is the largest radius of the vane.

Suppose there are "n" sectors, each including α radians. Then their areas are in the ratio —

$$\frac{\alpha}{2} \times 0, \frac{\alpha}{2} \times 1, \frac{\alpha}{2} \times 2, \frac{\alpha}{2} \times 3, \text{ — — — —}$$

$$\frac{\alpha}{2} \times R^2.$$

But since these areas are proportional to r^2, which itself increases uniformly from 0 to R^2, the average value being $\frac{R^2}{2}$, the average value for the area of a sector is—

$$\frac{\alpha}{2} \frac{R^2}{2} = \frac{\alpha R^2}{4}.$$

But there are "n" sectors.

$$\therefore \text{ the area of the vane} = \frac{n \alpha R^2}{4} = \frac{\pi R^2}{4}.$$

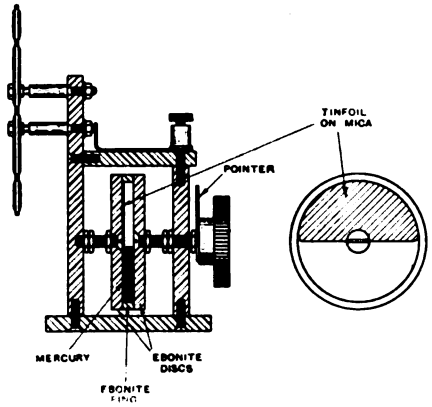
(It should be noted that the author assumes that the stray capacity of the circuit in which the condenser is connected is zero.—ED.)

READERS' PRACTICAL IDEAS

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

A Novel Tuned Circuit.

THE accompanying drawing shows a simple method of mounting a plug-in coil on two valve pins which are connected



A tuned circuit comprising a plug-in basket coil and a novel variable condenser.

with the receiving set through a pair of valve sockets. The ebonite supports are used to carry also a novel type of variable condenser which consists of two discs spaced apart by an ebonite ring. The ring must be held securely in position by small brass pins. A piece of zinc or tin foil is mounted to the face of one of the discs as shown, whilst a quantity of mercury exactly half fills the space between the two discs. The face of the metal foil is covered with a piece of mica. It will be seen that the capacity of the piece of foil and the mercury changes as the apparatus is revolved.

The reader is reminded that mercury has a very corrosive action upon aluminium and for this reason the finished instrument should not be mounted too near to a variable condenser built up with aluminium plates.

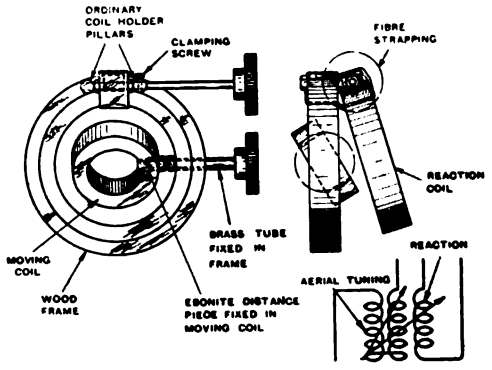
W. S.

Variometer with Reaction.

MANY single valve sets have variometer tuning in the aerial circuit and the difficulty arises as to a suitable method of producing a variable reaction coupling with the windings of the variometer.

A specially designed variometer must, of course, be employed and the necessary practical details for mounting the reaction coil are shown in the figure.

R. W. C.



A variometer having an additional coil for reaction.

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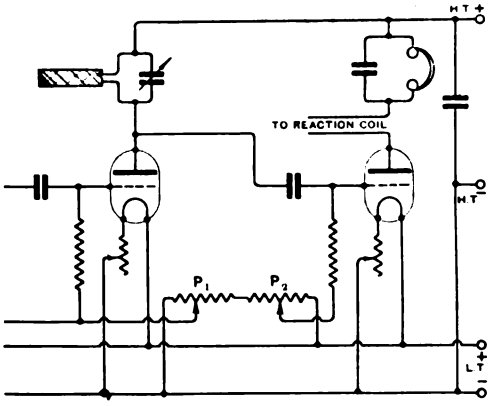
Potentiometer Grid Control.

THE accompanying diagram shows a useful method of using two potentiometers (P1 and P2) for controlling the grid potential of the H.F. and detector valves.



An arrangement of two potentiometers for giving fine control of grid voltages.

It will be seen that the windings of the two potentiometers are connected in series across the L.T. battery. The slider of P1 supplies a potential from zero to maximum negative suitable for controlling the H.F. amplifying valve, while P2 applies a potential from zero to maximum positive such as is usually needed when a valve is used as a rectifier in conjunction with the usual grid condenser and leak.

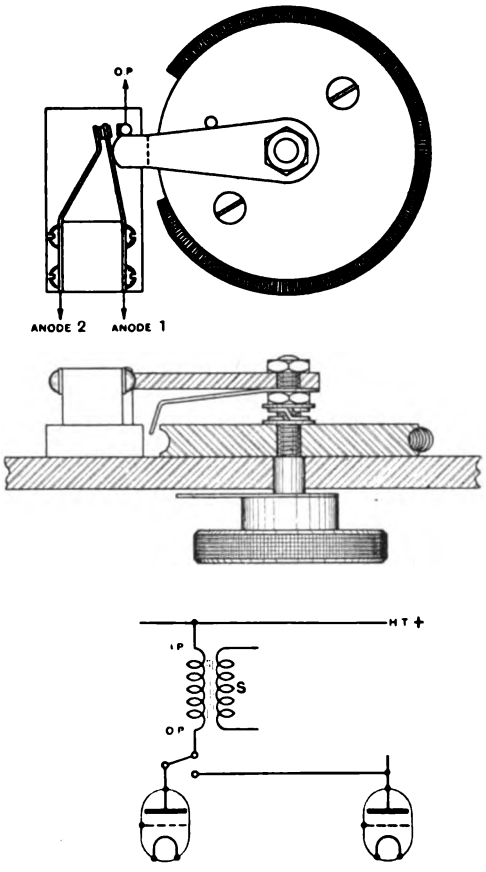
Thus it will be seen that half the voltage of the L.T. battery can be tapped off along either potentiometer, and this range is usually all that is required.

By connecting up in this manner it will be seen that the current taken by the potentiometer circuit is halved, but more important than this is that for a given movement of the slider a much more critical control of potential is obtained as the voltage of the battery is in effect dropped across a potentiometer of twice the normal dimensions.

R. S.

L.F. Switching Device.

NOTE magnifiers can be thrown out of circuit without the use of specially provided switches by causing the arm of the filament resistance to operate a spring contact. The drawing shows the actual form of construction, and from which it will be noticed that an additional ebonite arm is locked on the rheostat spindle. When the sliding contact of the resistance is in the "off" position it will press against a spring blade, pushing it over and producing the necessary circuit change to take the inter-valve transformer out of circuit.



Automatic switching device.

This will be found a particularly useful method, as it is only necessary to turn off the filaments of valves not required.

J. E. N.

Interchangeable Crystal Detector.

BY assembling the crystal contacts to plug and socket mountings it becomes possible to interchange various types of crystals and in addition to reverse the direction of the potential applied to the detector. As well as providing interchangeability both crystal and contact can be rotated and if the plugs make a good tight

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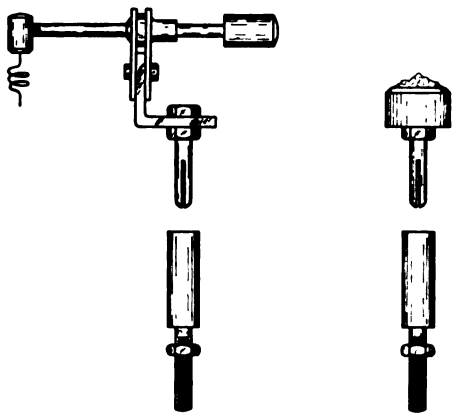
fit in the sockets, the relative height of the two contacts can be critically adjusted.

A. E. D.

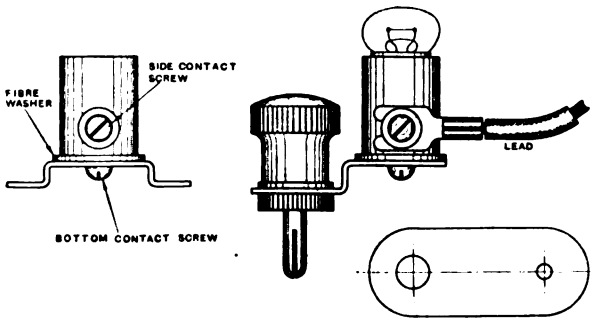


An arrangement of crystal detector and contact.

Combined H.T. Battery Fuse and Switch.

THE use of a small lamp to protect the H.T. battery against short circuit is in general use. A convenient form of mounting is shown in the accompanying drawing and the screw holder is a standard one such as can be readily purchased. By means of a small brass bracket, details of which are shown, it can be attached to a wander plug so that the lamp is located close to the point of H.T. distribution. Thus a contact between the flexible leads themselves will cause a breaking of the battery circuit. The use of a protecting fuse of this sort is strongly recommended, for not only does it guard against damage to the battery but also protects the valve filaments should a valve be incorrectly inserted. The lamp selected should be of very low rated candle power and preferably of the ½-watt type so that it will burn out with a very small current.

F. C. H.

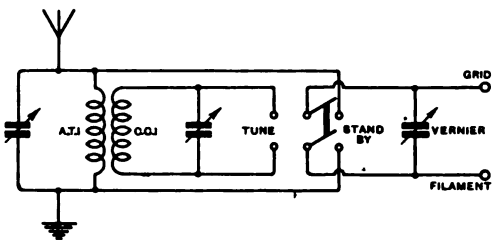


An H.T. battery fuse.

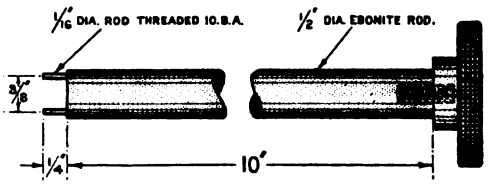
The Position of a Vernier Condenser in a Receiving Circuit.

THERE is no need as a rule to provide a vernier condenser in both the aerial and closed circuits, though if a tune-stand-by switch is fitted, vernier control must be available in whichever position the switch may be thrown. The vernier condenser should therefore be fitted across the centre contacts of the switch and thus vernier control is always available.

F. S. R.



Connections of a vernier tuning condenser.



Simple anti-capacity handle.

Anti-Capacity Handle.

WHEN receiving on short wavelengths it becomes essential in many receiving sets for the hand to be well removed from the components while tuning.

This anti-capacity handle is constructed from ⅜ in. ebonite rod and is fitted with two small brass pins either threaded 10 B.A. or merely driven a tight fit into the end of the rod. These pins engage in holes made in the centre of the instrument knobs.

C. L.

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VALVE TESTS.

THE BRITISH THOMSON-HOUSTON CO.'S B.6 VALVE.

WE have recently conducted a series of tests on the new B.T.H. valve, the B 6, and the results obtained are summarised below. Purchased in the ordinary way across the counter at a well-known dealers, the valves tested may be considered as typical of their type, and the results obtained are those which may be expected by any user. The B 6 may be classed as a low consumption power valve. The filament normally operates on 3 volts, taking a current of 0·12 ampere, and is therefore within the range of dry cell working should necessity so demand.

When operating as an amplifier potentials up to 120 may be applied to the plate, a grid bias of −3 volts with 80 volts on the plate, and −4·5 with 120 being suggested by the makers.

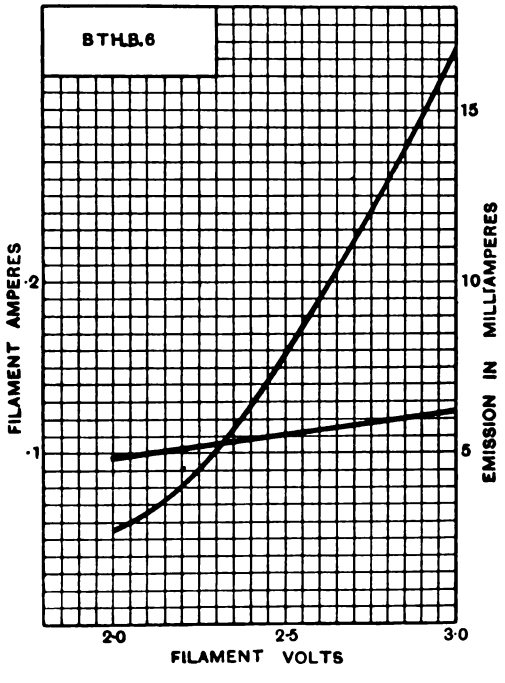

Fig. 1. Curves showing the relationship of emission and filament current to filament volts.

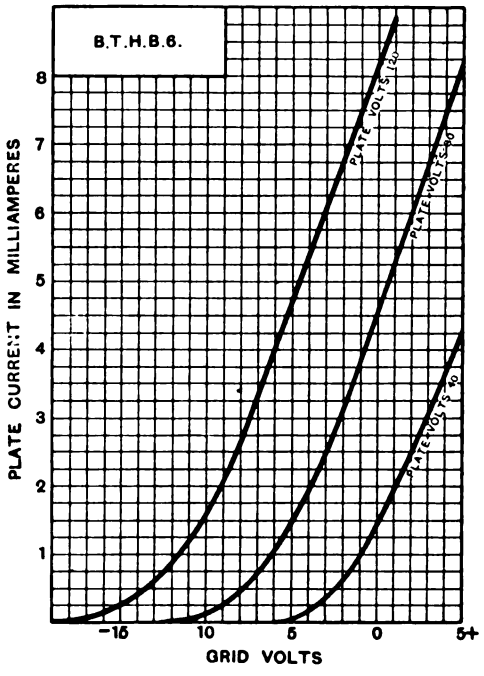

Fig. 2. Plate current-grid volts characteristic.

The filament system of the B 6 is rather out of the ordinary and merits description. Two straight filaments are used and are connected in parallel, the central support being a common lead. Since the two filaments are in parallel, and together take 120 milliamperes (0·12 ampere) each single wire takes 60 milliamperes (0·06 ampere), and the system thus consists of two 60 milliampere filaments connected in parallel across the filament supply. In Fig. 1 we show the usual filament characteristics, the current and emission at normal volts being 0·125 ampere and 16·5 milliamperes respectively. The efficiency is therefore of the usual order with filaments of this type.

Plate-current grid-volts characteristics are given in Fig. 2, and indicate good L.F. performance at plate potentials of 80 and over, according to the input. The curves,

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moreover, suggest a grid bias of about −3 to −5 volts, as the plate voltage is raised from 80 to 100, which is in very close agreement with the makers' figures. The magnification and resistance curves are shown in Fig. 3. The former factor is around 7·75, and the impedance varies between 20,000 and 10,000, according as the plate voltage is increased from 40 to 100. At the higher values the ratio of magnification to impedance is good, a result due, at least in part, to the modern electrode design, which, it should be mentioned, is being adopted by several valve manufacturers just now.

On circuit, and used in the second stage of a low frequency amplifier, we obtained excellent results with this valve, the output from a medium size loud speaker being clean and free from distortion. We operated the valve under the following conditions: 3 volts across the filament, plate potential 120, grid bias negative 6.

Although the B 6 is not put forward as a general purpose valve, we tried it out both as a H.F. amplifier and detector. About 50 volts H.T. gave the best results in both cases, but very critical adjustment seemed unnecessary, in addition to which the filament could be dimmed quite considerably before noticeable reduction in signal strength occurred.

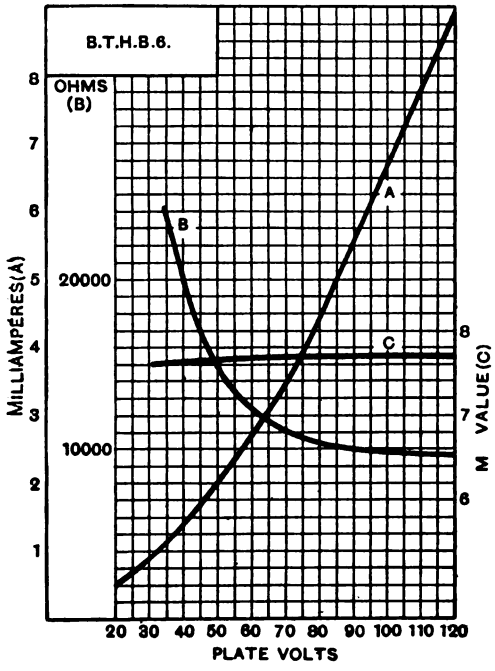
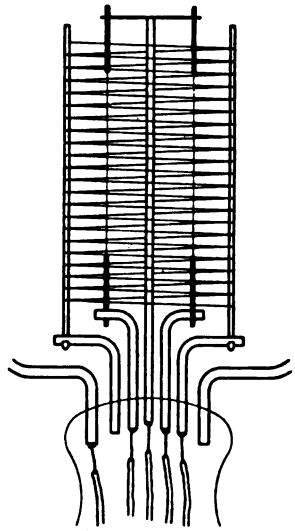


Fig. 3. Curves showing the plate current (A), impedance (B), and amplification factor (C) for various plate voltages.



Showing the peculiar arrangement of the filament of a B.T.H. B 6 valve.

TWO INTERNATIONAL RADIO CONVENTIONS.

The International Committee on Wireless Telephony, which was founded in 1923, is planning to hold an international conference in Paris from April 16th to 20th, 1925. Twenty-seven nations are represented in this organisation, which is in close touch with the League of Nations, the International Chamber of Commerce, the International Law Association, and many other influential bodies.

Items on the agenda of the conference include—(1) The allocation of wavelengths and State control; (2) International broadcasting regulations; (3) Authors' rights, and publicity matters.

The International Conference of Radio Amateurs will probably meet at the same time, and among the questions which the amateurs will discuss will be—(1) The founding of an international union of radio amateurs; (2) the methodical organisation of amateur tests; (3) the wavelength problem; (4) wireless in education; and (5) an auxiliary international language. The address of the Secretary of the Amateur Conference is 2 Rue de l'Echaude-Saint-Germain, Paris.

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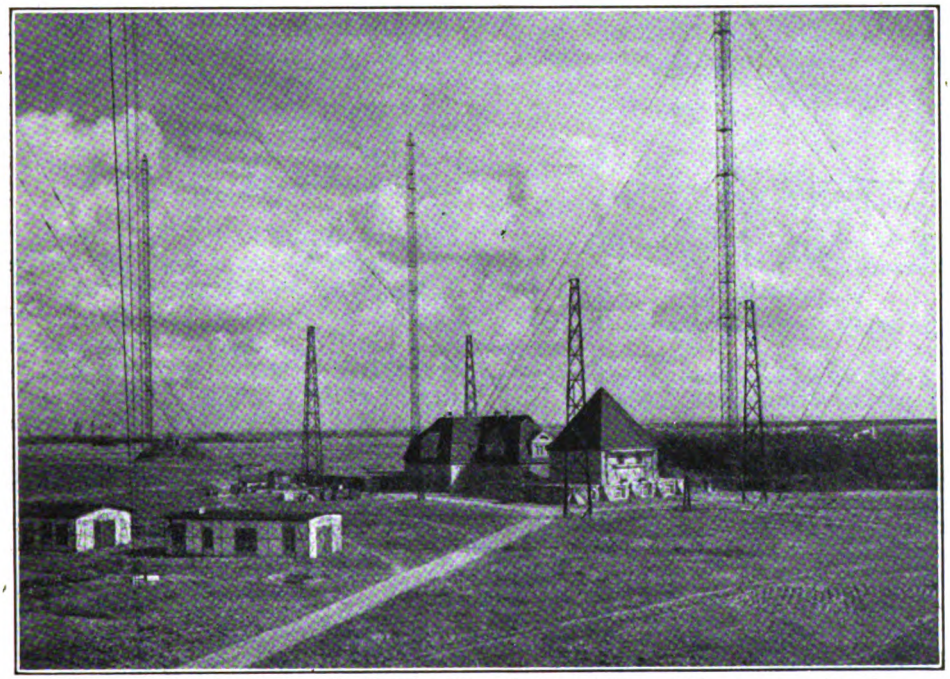
INTERNATIONAL RADIO WEEK.

REPORTS of reception, during the recent tests, of the American stations on this side continue to come in, and it is easy to see that the two predominating stations are **WGY** and **KDKA**, whilst a number of others appear to have been successful, though it is necessary to wait for details of their programmes before it is possible to confirm reception in every case.

We take this opportunity of thanking those who have so kindly sent in their reports of reception, and whilst there must be some delay before these can all be sorted up, it is hoped to acknowledge receipt of each communication individually in due course.

We should welcome further reports from others who have not yet sent them in, as every contribution is of value in assisting to identify stations, particularly where call signs have not been heard distinctly. After acknowledgment here all reports will be sent to Mr. Arthur Lynch, the Editor of *Radio Broadcast*, who organised the tests on the American side, so that he will be in a position to check up each reception with the actual programmes transmitted at the stations. Cables received from Mr. Lynch indicate that on his side he is inundated with reports of the reception of the British and Continental stations, and as these reports run into very many thousands, the task before him of sorting them up is a very big one, particularly in view of the fact that he has cabled over on more than one occasion to the effect that he is receiving from some listeners in America, claims that they have heard individual European stations at times when these stations were not transmitting! The imagination of some American listeners must add considerably to the task of sorting out the reports there.

It will be necessary to wait until a sufficient time has elapsed for the American reports to be gone through before a complete account of the results of the transmissions from this side can be published in *The Wireless World* so that there is not likely to be any further information of interest to give to our readers until this account is available.



The transmitter building of the Koenigs Wusterhausen station which participated in the transmissions to America.

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THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

A Quick Method of Finding the Amplification Factor of a Valve.

WE have explained* two methods of finding the amplification factor from the grid volts—anode current static characteristic curves of the valve. It is not necessary, however, to go to the trouble of plotting these curves if one desires to know the approximate amplification factor of the valve. We may proceed as follows.

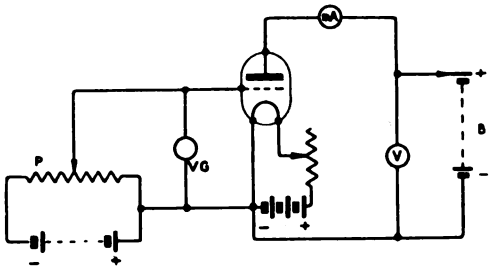

Fig. 1. One circuit arrangement employed when finding the amplification factor.

Connect a milliammeter (mA, Fig. 1) which need not be accurately calibrated, in the anode circuit with the normal anode battery B, and join the grid through a potentiometer P to the negative side of the filament. The voltmeter VG will read the voltage of the grid with respect of the filament, and V the voltage of the anode.

Note the readings of the milliammeter and the grid and anode voltmeters. They might read, for instance, 4 milliamperes, — 3 volts and 60 volts respectively. Now increase the anode voltage by, say, 9 volts (which is roughly the voltage of 6 dry cells). The anode voltage is now 69 volts, and of course the anode current, as shown by the milliammeter, has increased—say to 5 milliamperes. Then the effect of adding 9 volts to the anode voltage is to increase the anode current by 1 milliampere.

Now reduce the anode current to the value it had before (namely 4 milliamperes) by making the grid more negative—that is by moving the sliding contact of the potentiometer P in the grid circuit to the left. Let us assume that now the grid voltmeter reads — 4 volts. The effect of making the grid 1 volt more negative is therefore to reduce the anode current by 1 milliampere. Hence the effect on the anode current of increasing the anode voltage by 9 volts has been counteracted by adding 1 volt to the negative potential of the grid. That is to say, a voltage applied to the grid is nine times more effective than a similar voltage applied to the anode; the amplification factor of the valve under the conditions of the test is therefore 9.

* In the last number of this journal (December 3rd, 1924).

Another Method.

One may dispense with the voltmeters employed in the last method when only a rough idea of the amplification factor (which is all that is needed in many instances) is required. Thus, suppose we wish to get an idea of the amplification factor of a valve employed in the last stage of an amplifier, Fig. 2. The secondary winding of a transformer PS is connected to the grid and to the

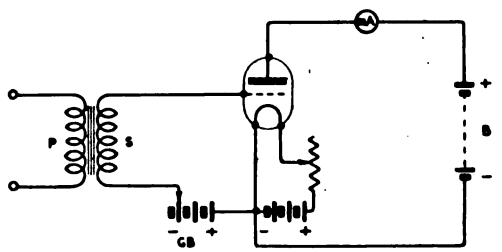

Fig. 2. Explaining another method of finding the amplification factor of a valve.

filament through the usual grid battery. Connect a milliammeter in the anode circuit (an instrument of any type which will give a readable deflection and has a fairly low resistance will do), and the normal anode battery. Note the reading of the milliammeter. Now connect one more cell in the grid circuit, which makes the grid about 1·5 volts more negative. This has the effect

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of reducing the anode current. To bring the anode current back to its normal value add cells, one at a time, to the anode circuit. If the anode current is restored to its original value by adding 9 cells to the anode circuit, we may take the amplification factor as being 9. The assumption made here, of course, is that the cells have identical voltages, which is not always true, even though the cells are new ones. The simplicity of the method should, however, appeal to the man who does not possess accurate measuring instruments.

The Anode Impedance.

By the anode (or internal) impedance of a valve is meant the effective resistance of the anode-filament path through the valve to varying or alternating currents. The anode impedance depends on the construction of the valve and the operating conditions. It depends, for instance, on the distance between the anode and filament, the area of the anode, and the construction and position of the grid. The impedance is roughly inversely proportional to the area

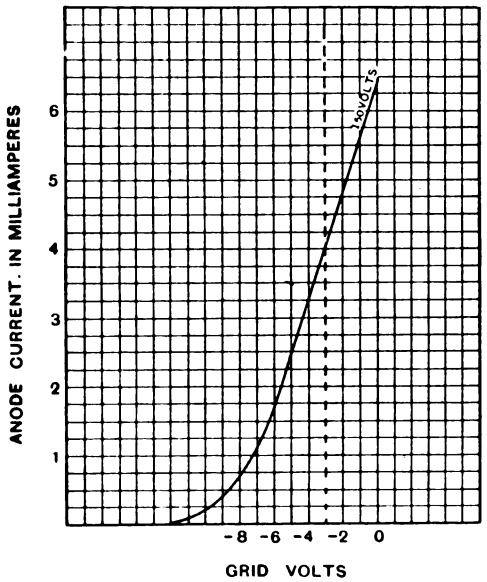

Fig. 3. A characteristic curve.

of the anode. If the area is increased, the impedance is reduced. By increasing the distance between the anode and the filament the impedance is increased.

The anode impedance does not remain constant for all values of filament current, grid and plate volts. For instance, if the filament current and grid volts are fixed at

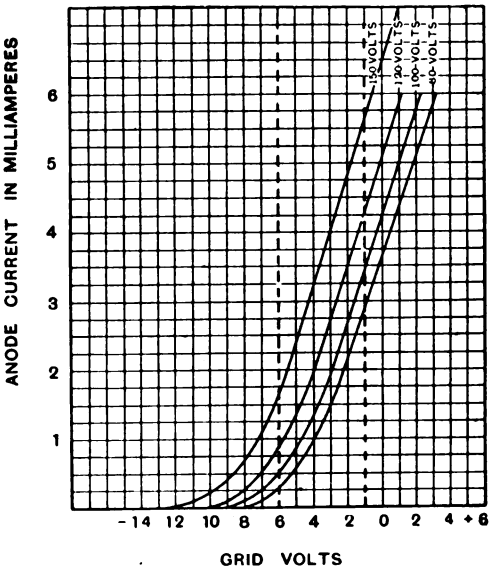

Fig. 4. A group of characteristic curves.

normal values, the anode impedance falls rapidly as the anode voltage is increased from a small value. For higher anode voltages the impedance does not fall so rapidly. If the anode volts and filament current are fixed at normal values, the anode impedance may increase or decrease, depending on the value of the grid volts.

The ordinary direct current resistance of a valve is, of course, found from the formula:

$$\text{Resistance (ohms)} = \frac{\text{Voltage (volts)}}{\text{Current (amperes)}}$$

The value of resistance found from this simple formula is not the anode impedance. For instance, the direct current resistance of the valve having the characteristic curve of Fig. 3, when the grid voltage is — 3 (shown by the dotted line) is $\frac{150}{0.004} = 37{,}500$ ohms.

The anode impedance is equal to the ratio of the change in anode volts to the change in anode current for a given grid voltage. It may be found from the characteristic curves† which were used when finding the amplification factor.

† The method of finding the characteristic curves of valves was described in the last number—page 320.

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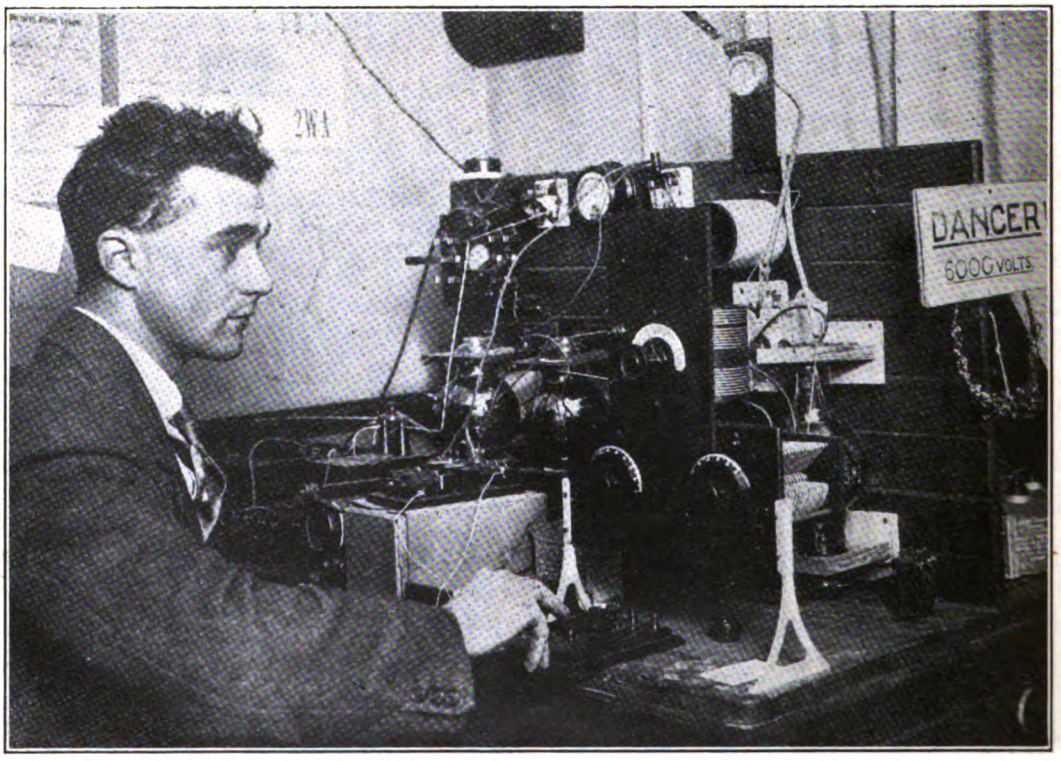
Thus, referring to the characteristic curves of Fig. 4, we see that when the grid has a voltage of — 1 volt, and the anode a voltage of 120, the current is 4·25 milliamperes. If the anode voltage is increased to 150 volts the anode current increases to 5·7 milliamperes. That is, a change in anode volts of 30 produces a change in anode current of 1·45 milliamperes. The anode impedance is therefore $\frac{30}{0.00145}$ or 20,600 ohms.

When the grid has a potential of — 6 volts and the anode a voltage of 120 the anode current is 0·9 milliamperes, which increases to 1·6 milliamperes if the anode voltage is increased by 30 volts. The impedance under these conditions is therefore $\frac{30}{0.0007}$ or 43,000 ohms. This is a considerably larger value than when the grid bias was — 1 volt. The reason may be seen by carefully examining the curves. They are not parallel. The distance between the curves decreases as the negative grid voltage is increased. One may therefore find by an examination of the curves whether the impedance varies with the anode and grid voltages.

AN EFFICIENT AMATEUR TRANSMITTER.



Mr. J. H. Ridley **(5NN)**, *the South Norwood transmitter who has recently worked with three of the New Zealand amateurs, besides a number of U.S. and Canadian stations. On November 25th he picked up signals from the Mexican amateurs* **DZ** *and* **BX.**

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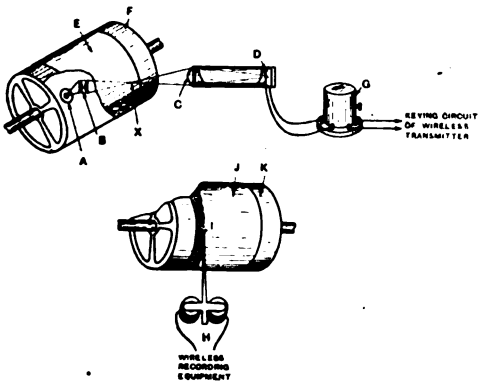
PHOTOGRAPHS BY WIRELESS

SUCCESSFUL TRANSMISSIONS ACROSS THE ATLANTIC

THE problem of the transmission of pictures by telegraphic means is one which has exercised the ingenuity of inventors for some time past. More recently, as some successful results have been obtained, the possibility of wireless transmission of photographs has been considered. In this connection very interesting experiments were carried out on the afternoon of November 30th between Radio House in London, and New York. The apparatus used is described as the invention of Mr. R. H. Ranger, developed by the Radio Corporation of America. This company, as is well known, acts in association with Marconi's Wireless Telegraph Co., in England. At the time of conducting the tests transmitting equipment only had been set up in England, receiving apparatus having not yet been supplied from America. It is expected that in the near future this system, which, although not altogether novel in principle, has been developed to a high degree of efficiency, will at an early date be available for commercial application. The



Explanatory sketch showing the general principle of the apparatus. A, "pointolite" lamp; B, condensing lens; C, focussing lens; D, sensitive photo-electric cell in adjustable mounting; E, transparent image; F, rotating cylinder; G, relay; H, electromagnet controlling stylus; I, self-inking stylus; J, rotating paper; K, revolving drum.

A photograph of President Coolidge transmitted by the system described.

sketches reproduced here are intended to show the general principle of operation of the apparatus, but do not, of course, give any details of the arrangements.

At the transmitting end is a glass cylinder F, round which a photographic film E to be transmitted is fixed. Inside the cylinder is a powerful source of illumination A. A lens converges illumination on to a point on the film, and the beam of light is then focussed on to a photoelectric cell D located at some distance from the cylinder. In order to transmit a picture the glass cylinder bearing the film is rotated, and as darkened or opaque patches of the film move by they control the amount of illumination which reaches the photoelectric cell. In the course of transmission the cylinder is gradually moved on and reverses its direction of rotation each time it reaches the edge of the picture. Variations of illumination on the photoelectric cell produce variations of current in the circuit in which the cell is included owing to the changes in the resistance of the cell so produced. These changes in current flow can be utilised to control a wireless transmitter, or, for the

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purpose of illustration, we may imagine that they control directly an electro magnet H, which in turn controls the mechanical movement of a pen acting upon another cylinder K carrying a sheet of paper J. As the cylinder is rotated back and forth in synchronism with the cylinder of the transmitter, so dots or blank patches will appear on the paper coinciding with the opaque or dark patches of the film. In the transmitted picture of President Coolidge, which we illustrate here, the points made by the pen can be distinctly seen, and it may be mentioned that in this instance the spacing between the successive rows of dots is 1/64 in. In the transmissions made from New York the movement was 1/128 in. for each revolution, so that finer detail was obtained in the finished picture, although more time was required to effect the transmission, which, for a half-plate film, occupied approximately 20 minutes. According to reports, the demonstration of reception in America was extremely satisfactory. It was unfortunate that it was not possible to demonstrate reception in this country owing to the absence of receiving apparatus, but no doubt it will be possible to witness reception also at a later date, when arrangements will be made for the complete experiment to be carried out. The transmissions from Radio House were witnessed by a considerable gathering of press representatives, and amongst the photographs sent to America were portraits of the Queen, Queen Alexandra and Mr. Baldwin.

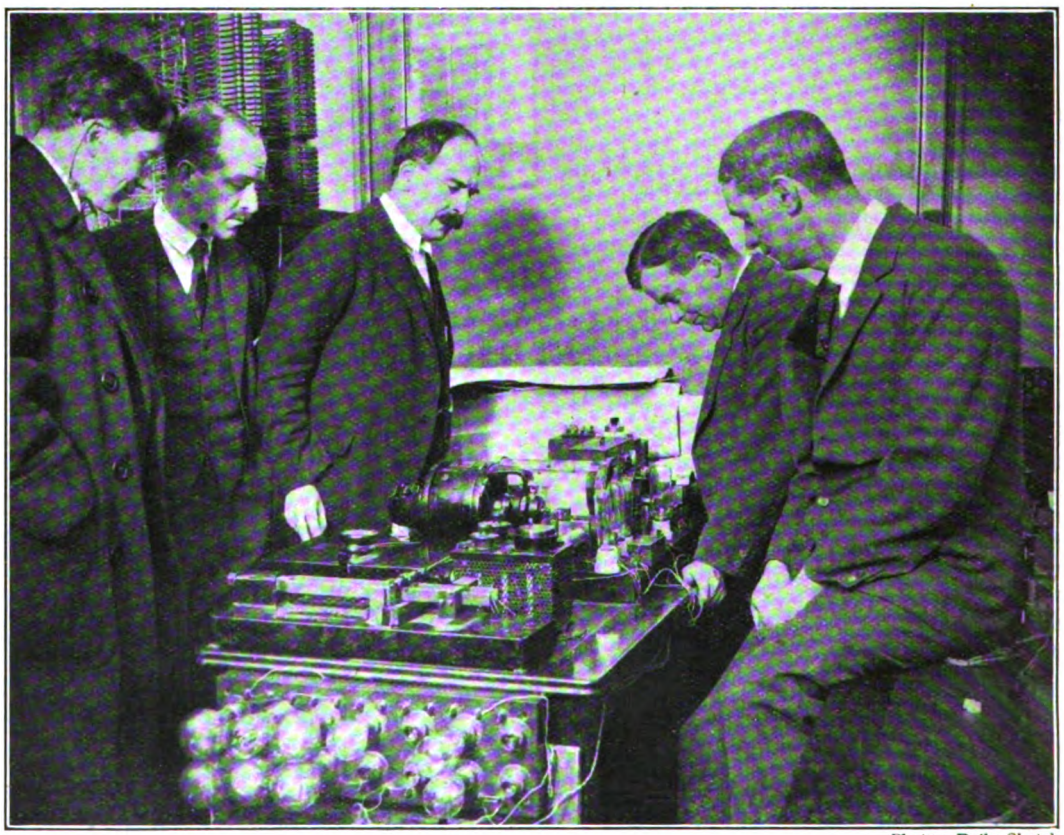

Photo: Daily Sketch

The transmitting apparatus installed at Radio House. The tuning fork shown in the front serves to synchronise the motor with the motor at the receiver controlled by a similar tuning fork.

The photograph which we reproduce on this page shows the apparatus installed at Radio House with Mr. G. S. Whitmore, Chief Communication Engineer of the Marconi Company, standing in the centre, watching the operations.

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PATENTS AND ABSTRACTS

Low Frequency Amplifiers.

In the issue of this journal of June 4th, 1924, was described an amplifier using the push-pull system of amplification, in which

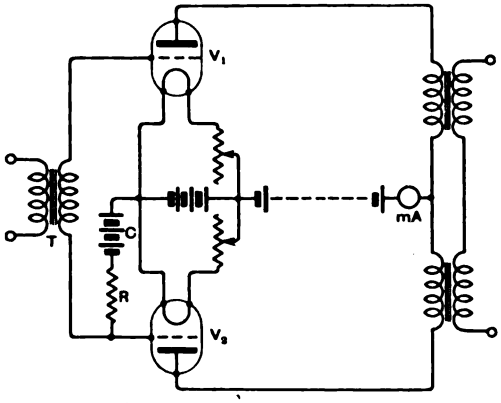

Fig. 1. *A special amplifying system.*

the secondary winding of the input transformer and the primary winding of the output transformer have a centre tap. According to Patent No. 222,981, it is possible to dispense with the special input transformer,

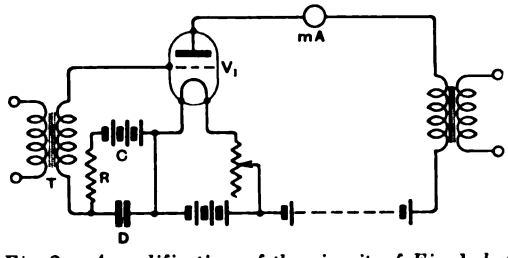

Fig. 2. *A modification of the circuit of Fig.* 1, *but using one valve.*

and to employ an ordinary transformer as indicated in Fig. 1. The secondary terminals of the input transformer T are connected to the grids of the valves V_1 and V_2, and a high impedance R is connected between one grid and the filaments, preferably through cells C, to act as a return path for the grid.

If the voltage to be amplified is not so great that the valves have to be used differentially, only one valve (Fig. 2) need be used. A condenser D should be connected in place of the grid-filament path of the unused valve.

A Vernier Adjustment.

A convenient vernier adjustment is sketched in Fig. 3, where 1 is the spindle of a tuning condenser or variometer, 2 the panel, 3 the knob of the instrument, 4 the vernier adjusting knob, and 5 a support for the spindle of 4.

In the construction shown in the figure (described in Patent No. 224,973), a toothed

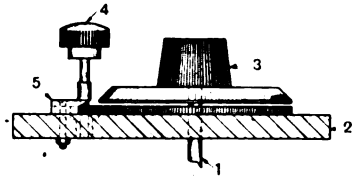

Fig. 3. *A vernier device.*

wheel is mounted on the spindle between the panel and the dial of the knob, and a smaller wheel is mounted on the spindle of the vernier control.

Instead of employing separate gear wheels, teeth may be moulded on the lower side of the dial, or it may be found more convenient to mount the gears below the panel.

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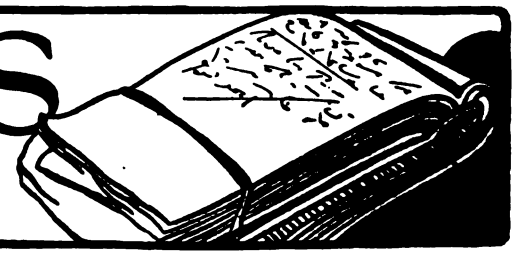
NOTES & NEWS



At the recent wireless conference in Johannesburg it was announced that the Post Office would collect broadcasting fees next year, and would prosecute unlicensed listeners.

* * * *

In consequence of the unexpected demand for the list of New Zealand amateur transmitters referred to in these columns last week, we have decided to publish the list in our next issue.

* * * *

The Lyons Fair for 1925, which will be held from March 2nd to 15th, is expected to contain exhibits from twenty different countries. The radio industry should be well represented.

* * * *

A performance of the opera, "Prince Igor," at the Brussels Opera House, on December 15th, will be relayed by wireless from the Brussels station and broadcast from **5 XX.**

* * * *

An experiment in the open-air reception of broadcasting was recently carried out with success in Bombay, when a musical programme was reproduced on loud speakers to a large audience.

* * * *

A new transmitters' society has been formed by transmitting amateurs in Bristol and the surrounding districts. The Hon. Secretary is Mr. W. A. Porter, **2 AKG.**

* * * *

128 AMERICANS AT A SITTING.

Mr. S. K. Lewer **(6 LJ)** of West Hampstead, reports that on Sunday morning, November 23rd, he logged 128 American amateurs, using only a single valve.

AUSTRALIA WITH 'PHONES ON BENCH.

At 6.55 p.m. on Friday, November 26th, Mr. E. J. Simmonds **(2 OD)** of Gerrard's Cross, added to his laurels by receiving the Australian **3 BQ** at "'phones-on-the-table" strength. Two test messages had been passed prior to this, and at 6.40 the Australian's signals had gradually increased until they reached their maximum strength at the time mentioned. The signals were also received comfortably on a single detector valve.

Successful two-way working with the Australian **3 BQ** was accomplished by Mr. J. A. Partridge **(2 KF)** of Merton Park, on Sunday, November 30th. Communication was maintained for about five minutes at 7 p.m. and the Australian reported good signals from both **2 KF** and **2 NM** (Mr. Gerald Marcuse).

M. DELOY HEARD IN THE TRANSVAAL.

According to our Paris correspondent, signals transmitted by M. Leon Deloy, of Nice, were heard clearly at Johannesburg on October 19th, at 3.35 a.m. by Mr. S. C. Pleass. The distance covered is about 5,000 miles, mostly overland.

IMPROVED U.S. NAVAL WIRELESS.

Amateurs on the American coasts are rejoicing at the installation of new high power transmitting apparatus on twenty-one first line U.S. battleships. This is a great step towards the abolition of the constant interruption from the old spark and arc transmitters of the navy, which has continually interfered with broadcast reception in the past. The new apparatus, designed by the Western Electric Company, has greatly increased the range of communication, and the "Colorado" has been able to communicate from Gibraltar to Chatham, Mass. Water-cooled valves are employed and power is supplied from the same generator as formerly fed the spark transmitter.

CONGRATULATIONS FOR G 2NM.

Mr. Gerald Marcuse **(2 NM)** has received a card from Argentine **DA 8 (ex CB 8)**, reporting his signals as steady and of good strength on October 30th, when calling New Zealand and congratulating him on being the first British amateur to be received in the Argentine.

BELGIAN CALL SIGNS.

M. Henrotay, President of the Radio Club Belge de l'Est, wishes to remove the widespread impression that amateur call signs commencing with "4" are of German origin. They are in fact Belgian stations, the only exceptions being two or three stations in the occupied Rhine area. Belgian transmitters have been asked to prefix their call signs with the letter "B."

HEAVISIDE LAYER AND AMATEUR COMMUNICATION.

The possible influence of the Heaviside layer on the success of amateur communication between this country and New Zealand was discussed by Mr. Gerald Marcuse in the course of his talk from **2 LO** on Thursday, November 27th.

"In order to get data on this subject," said Mr. Marcuse, "special tests were arranged whereby American stations along the route which the waves were supposed to traverse, would keep watch and give reports of the signal strength as they received it, but their reports were contrary to expectation inasmuch as they reported weak signals, whereas New Zealand amateurs reported that the same signals were very strong. This lends favour to a suggestion that signals travelling to New Zealand jump the U.S.A., by which I mean

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that, when radiated from a given point, they travel towards the Heaviside layer or as it is sometimes called the 'ceiling,' and on reaching it are deflected. Another fact which supports this theory is that there are certain areas in the United States with which British amateurs have never yet succeeded in establishing communication, despite the fact that power equal to that used for communicating with New Zealand has been used. Another point which is not altogether out of the question, although many people will not listen to it, is that signals travel through the earth. Whether a satisfactory explanation of these points will eventually be produced in a matter upon which I will not express an opinion, but in any case, the success of these experiments should open up the way to further researches on interesting scientific phenomena."

BROADCASTING RUMOURS IN EGYPT.

The recent discontinuance of the issue of wireless licences in Egypt, states the American Trade Commissioner, has led to the rumour that the Government is contemplating the grant of a monopoly to an Egyptian wireless company. The general feeling is that this step would enable such a company to compel would-be listeners to buy its own products while paying a licence fee to the Government.

ACCUMULATOR SERVICE IN BRISTOL.

Bristol readers may be interested to learn that Messrs. Fuller's United Electric Works, Ltd., have taken new premises in connection with their Bristol depot at 22 Temple Street (Phone: Bristol 2531).

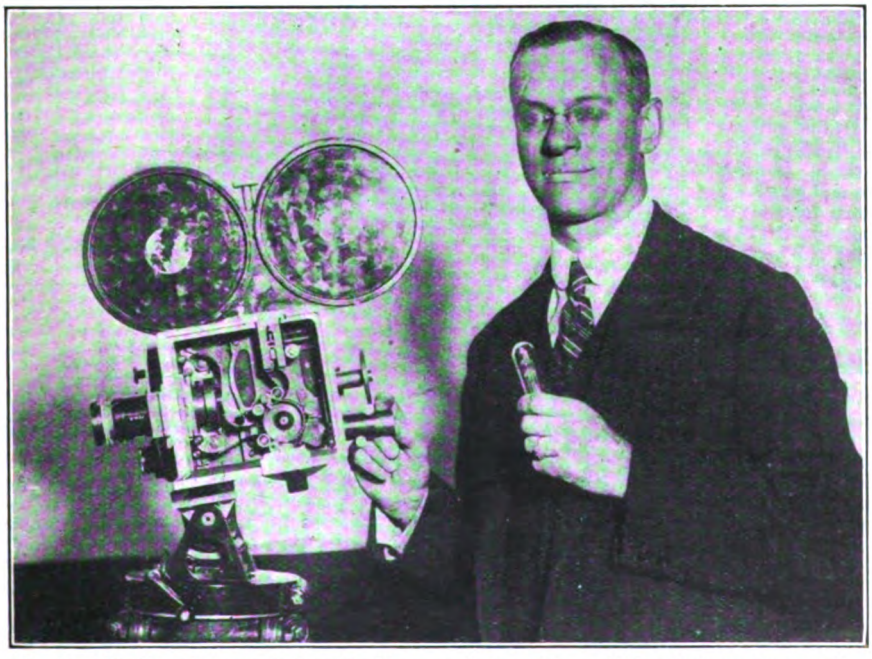
EIFFEL TOWER TRANSMISSIONS.

The following is the latest schedule of transmissions from the Eiffel Tower on a wavelength of 115 metres :—

4.0 to 5.0 a.m. (G.M.T.)	Repetition of "Le Verrier" and "Maury" weather report for America.
9.40 to 9.45 a.m.	America Weather Report.
2.20 to 2.55 p.m.	(*a*) France, Belgium, Switzerland and Holland Weather Report. (*b*) "Le Verrier" Weather Report for America.
5.0 to 5.30 p.m.	Observations of 1 p.m. from Europe and North Africa Stations and from ships in the Atlantic.
11.0 to 11.30	"Maury" weather report for America.

NEW TURKISH HIGH POWER STATION.

The establishment of a new high power radio station at Angora is the latest project of the Turkish Government. The two existing high power stations at Constantinople, which have not been in use since the departure of the Allied Armies, will be abandoned.



Mr. C. F. Elwell, photographed with his recent invention which photographs sounds whilst taking cinematograph pictures. The invention is made possible by the use of a valve amplifier in conjunction with an extremely sensitive microphone and a photoelectric cell. Mr. Elwell will lecture on "Photo-Electrics" before the Radio Society of Great Britain, on Wednesday, December 17th.

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NEW GREENWICH CLOCK.

After claiming to have broken all the world's records for accuracy of time measurement at the Edinburgh Observatory, the Synchronome Free Pendulum has now been installed at Greenwich Observatory. The erection of the Greenwich clock coincides with the election of its inventor, Mr. Hope-Jones, as a Fellow of the Royal Astronomical Society, and to the office of Chairman of the British Horological Institute.

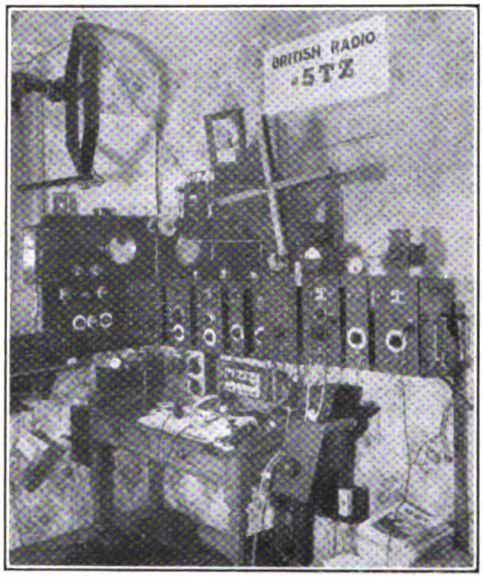
SOUTH AMERICAN BROADCASTING.

Listeners in Buenos Aires can enjoy music almost continuously from 10 a.m. until 1 a.m., according to a letter which has been received by Mr. Kenyon Secretan **(5 LF)** of Barnes, from a friend in South America. The station **LOR** commences its programme at ten o'clock in the morning and thereafter until the early hours of the next day, **LOR, LOX, LOY, LOE** and **LOZ,** all contribute concerts, news bulletins and market reports. The last-named station occasionally rebroadcasts the transmissions from **KDKA.**

Throughout South America there is a noticeable absence of British wireless apparatus, most of the sets being of American manufacture.

G 2 AWD.

If **G 2 AWD** will kindly communicate his address to Mr. W.D. Keiller **(6HR)** c/o the offices of this Journal, he will receive a souvenir card relating to his reception of **1 HT**'s signals during the latter's recent voyage to the Argentine.



This station, owned by Mr. Walter G. Sherratt, of Cowes, I.O.W., has been designed exclusively for short wave work. It has been heard in many European countries, and efforts are being made to reach the U.S.A., using 50 watts.

SWEDISH AMATEUR CALIBRATION WAVES

A useful series of calibration waves is to be sent out by the three well-known Swedish amateurs, **SMZS, SMZQ,** and **SMYY** from December 15th until December 20th. The exact schedule of transmissions which will take place daily at 6 a.m. (G.M.T.), is as follows :—

December	15th	50 metres
,,	16th	80 ,,
,,	17th	110 ,,
,,	18th	140 ,,
,,	19th	170 ,,
,,	20th	200 ,,

The transmissions in Morse will begin with a CQ call, followed by : "QRH.... metres. Pse QSL to Radio-Bladet, Stockholm," continuing for ten minutes.

STANDARDISATION OF EBONITE.

Some important facts about ebonite of value to every home constructor, were given by Mr. J. H. Reeves in the course of his broadcast talk from **2 LO** on Thursday, December 4th.

Mr. Reeves stated that he was indebted to the Hon. Secretary of the Ebonite Manufacturers' Association for the following information concerning composition of ebonite as bought by the ordinary amateur.

The materials used are very varied. The best ebonite is composed of about 67 per cent. rubber and 33 per cent. sulphur, but the proportion of rubber is often less than this 67 per cent., perhaps only 40 per cent. or even less, and the quality of the finished product diminishes or increases in proportion to the amount of rubber used. In the finished product there is little, if any difference in appearance, whatever be the proportion of rubber used, and the difference in quality can only be detected by tests which, although fairly easy to apply in a well equipped laboratory or ebonite works, are beyond the power of the ordinary purchaser.

The various ebonite manufacturers have their own idea as to the minimum quality, electrically and mechanically, which they think good enough for wireless purposes, and with a view to securing uniformity in this respect the Radio Society of Great Britain, in consultation with the Ebonite Manufacturers' Association, sent a joint letter to the British Engineering Standards Association requesting them to set up a Committee to determine a standard of ebonite for wireless purposes. This Association, generally known by its initials B.E.S.A. has consented to do so.

We believe that the B.E.S.A.'s procedure will be somewhat as follows : this Committee will be thoroughly representative of all the interests concerned, and will include in addition to certain of its own highly experienced staff, representatives of ebonite manufacturers, of builders of wireless sets, of technical bodies which have carried out research in insulating materials, and of the Radio Societies.

The proposals of this Committee will be put before the industry as a whole, and it is hoped that there will finally be published a specification as British Standard. Very soon after the specification is issued we may expect to find sheets and panels, and possibly small ebonite components, all bearing

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the B.E.S.A. mark in addition to that of the individual manufacturer. When this happens everyone who wishes to buy standard material will be able to assure himself that he will be getting what he demands.

Calls Heard

Walton-on-Thames, Surrey. (October 5th, 12th and 31st).
All American, on 80 metres: **1 AH, 1 MX, 1 FD, 1 AU, 1 ZZ 1 XZ, 1 BQ, 1 BG, 1 SF, 1 YO, 1 SW, 1 MY, 1 KC, 1 EE 1 ET 1 ML, 1 GY, 1 CG, 1 II, 1 XW, 1 AAL 1 BMT, 1 BQI, 1 ABT 1 BDT, 1 AAC, 1 CMP, 1 CKP, 1 CCQ, 1 BIP, 1 ADN 1 AHI, 1 AOM 1 CGR, 1 CAK, 1 BSD, 1 BFN, 1 AOU, 1 BGQ, 1 BKQ 1 AUN, 1 BIE, 1 AAU, 2 GK, 2 QW, 2 KU, 2 PD, 2 BE, 2 EM, 2 BRD, 2 APY, 2 MU, 2 ANA, 2 BRC, 2 CVS, 2 BGG, 2 ADJ, 2 CYW, 3 GK, 3 HH, 3 WB, 3 OG, 3 MR, 3 KD, 3 ZD, 3 AU, 3 BTA, 3 BSB, 3 CDG, 3 BDO, 3 ARI, 3 VW, 3 AUV, 3 BFE, 3 GC, 3 BOF, 3 BWT, 3 AJD, 3 ADG, 3 BCO, 4 IO, 4 ZD, 4 FS, 4 XX, 4 OA, 4 TJ, 4 RR, 4 XE, 4 EV, 5 KQ, 5 ZAS, 7 FR, 8 XC, 8 CYI, 8 BFE, 8 CLN, 8 UP, 8 DFW, 8 PL, 8 GHW, 8 CM, 8 BF, 9 EM, 9 LD, 9 DIN.** (o—v.—1)
F. Walker.

(October 26th to November 2nd).
British: **2 AM, 2 BA, 2 CA, 2 FP, 2 HS, 2 JA, 2 JL, 2 KF, 2 KT, 2 NM 2 OM, 2 PB, 2 PX, 2 QO, 2 QQ, 2 QS, 2 TA, 2 TY, 2 VD, 2 VS, 2 XR, 2 YM, 5 AG, 5 AS, 5 CQ, 5 CX, 5 DT 5 FL, 5 LF, 5 LP 5 MA, 5 NN, 5 OX, 5 PS, 5 RN, 5 RV, 5 RW, 5 RZ, 5 SQ, 5 UO, 5 WN, 5 XN, 6 AL, 6 HD, 6 JB, 6 TT, 6 DH, 6 GH, 6 LJ.** French: **8 AB, 8 AL, 8 BH, 8 BN, 8 BC, 8 BR, 8 CA, 8 CN, 8 CO, 8 DD, 8 DF, 8 DG, 8 FL, 8 GL, 8 JBV, 8 MN, 8 PB, 8 PD, 8 PF, 8 SR, 8 SSH, 8 SSC, 8 UIV.** Belgian: **4 YL, 4 YR, 4 RS.** Finnish: **FMNB.** Danish: **7 EC.** Unknown: **OXL, OMS, OZZ, 1 AO, QRA.**
L. S. Crutch (**2 AWH**).

London, N.1. (During October, 1924.)
British: **2 ABJ, 2 CC, 2 DR, 2 DX, 2 FK, 2 FM, 2 FP, 2 JF, 2 JU, 2 KD, 2 KF, 2 KG, 2 KW, 2 KY, 2 LH, 2 NM, 2 OM, 2 PX, 2 PY, 2 QQ, 2 QS, 2 UC, 2 UV, 2 VS, 2 WJ, 2 WY, 2 ZA, 2 XO, 2 XZ, 5 BE, 5 BV 5 CF, 5 FL, 5 GF, 5 LP, 5 MO 5 OX, 5 PD, 5 RZ 5 SI, 5 SU, 5 SZ, 5 UL, 5 UO, 5 WG 5 WN, 6 AL, 6 BBC, 6 BO, 6 DO, 6 DW 6 FG, 6 GH, 6 GM, 6 HC, 6 KG, 6 KJ, 6 LB, 6 LJ, 6 NF, 6 PD, 6 PX, 6 QT, 6 TD, 6 TM, 6 UD, 6 UT.** Foreign: French: **8 AL, 8 BF, 8 BN, 8 CA, 8 CN, 8 CO, 8 ÉN, 8 ÉU, 8 FI, 8 GI, 8 GO, 8 ML, 8 MU, 8 PA, 8 PD, 8 QG, 8 WL, 8 ZM, 8 ZZ.** Italian: **IDO, IHT.** Danish: **7 EC.** Dutch: **OBA.** Finnish: **3 NB.** Unknown: **3 ZZ, 4 QS, 4 UU, 4 YZ, 8 UMZ, PICR.** (1—v—o, and o—v—o.)
C. S. Bradley.

Stratton-on-the-Fosse, Nr. Bath.
Between October 30th and November 11th; below 200 metres.
British: **2 AG, 2 AMB, 2 ARB, 2 FN, 2 FNG, 2 JF, 2 MP, 2 MN, 2 XC, 2 ZG, 5 HA, 5 IP, 5 LF, 5 QP, 5 RQ, 5 RY, 5 SV, 5 SZ, 5 UG, 5 UQ, 5 WI, 6 XJ.** French: **8 AG, 8 AL, 8 AP, 8 AQ, 8 BC, 8 BR, 8 CK, 8 CO, 8 CPP, 8 CR, 8 CS, 8 DF, 8 DP, 8 EC, 8 ÉM, 8 ÉV, 8 FG, 8 FS, 8 GH, 8 GM, 8 HSM, 8 II, 8 IP, 8 JDL, 8 MN, 8 PB, 8 QG, 8 RB, 8 RL, 8 SM, 8 TM, 8 WAL, 8 XH, 8 ZM.** Swedish: **SMYY, SMZV, SMZY, SMZZ.** Dutch: **0 AD, 0 II, 0 MS.** Belgian: **5 UU, B 7.** Italian: **1 FP.** Danish: **7 ZM.** Miscellaneous: **3 AF, 3 CM, 9 AD.** (o—v—o: Reinartz).
Downside School Wireless Society. (**2 XM**).

MISUSE OF CALL SIGN, 2 XD.

Mr. H. R. Gladwell (**2 XD**), of Romford, Essex, has reason to believe that his call sign is being used by a powerful station working on 100 metres. Many reports of such a station have been received from the West of England. Mr. Gladwell has never transmitted below 150 metres.

CATALOGUES RECEIVED.

Burndept, Ltd. (Aldine House, Bedford Street, London, W.C.2). 1924-25 Catalogue of Wireless Apparatus, Section V: Transmitting apparatus. A 16-page booklet of particular interest to transmitters. Publication No. 247, containing full illustrated descriptions of the Burndept range of receiving apparatus and accessories. Price 1s.

L. McMichael, Ltd. (Hastings House, Norfolk Street, W.C.2). Illustrated Catalogue of McMichael Broadcast Sets, Home Assembly Sets, Components and accessories.

Carfax Company, Ltd. (312 Deansgate, Manchester). Price List of Carfax Wireless Sets and Accessories, and of the "Kodel" portable set.

Fuller's United Electric Works, Ltd. (Woodland Works, Chadwell Heath, Essex). List 315b, describing and illustrating Sparta Radio Accessories.

Radio Society of Great Britain.

RADIO SOCIETY OF GREAT BRITAIN.

The Eleventh Annual General Meeting of the Society will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2., at 6 p.m., on Wednesday the 17th December, when a lecture on "Photo-Electrics," will be given by Mr. C. F. Elwell, M.I.E.E., Fellow I.R.E. Tea at 5.30 p.m.

T. & R. NOTES.

The principal events of the week are the continued activities of the Australian amateurs who come in very well during the evening from 6 to 7.15 p.m. after which they fade away, doubtless owing to sunrise in Australia. The Australians most frequently logged in this country are **3 BQ, 2 CM,** and **2 DS,** and the first-named has been worked by several. I would, however, specially ask our friends across the Channel to keep above 85 metres, as on Saturday and Sunday, November 29th and 30th, when **3 BQ** was calling me, considerable interference was caused by a transmitter using raw A.C.

Mr. Jack Orbell reports good reception of **3 BQ** and states that on November 30th he heard good signals from this station on his loud speaker, using two valves.

GERALD MARCUSE,
(*Hon. Secretary Transmitter and Relay Section, Radio Society of Great Britain*).

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 10th.

Radio Society of Great Britain. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Talk on "Supersonic Heterodyne." By Mr. W. K. Alford.

Streatham Radio Society. At 35 Streatham High Road, S.W. Lecture: "Amplification." By Mr. H. A. Thomas, M.Sc.

Radio Research Society, Peckham. At 44 Talfourd Road. Lecture: "Dynamos and Motors." Discussion: "Switching of Valve and Crystal Receivers."

Bristol and District Radio Society. Wireless Lecture No. 7. By Mr. W. A. Andrews, B.Sc.

Edinburgh and District Radio Society. At 8 p.m. At 117 George Street. Film: "An Englishman's Home." Kindly lent by the General Electric Co., Ltd.

North Middlesex Wireless Club. Members' Loud Speaker Competition.

Sutton and District Wireless Society. At 8 p.m. At the Sutton Adult School, Benhill Avenue. Free demonstration and lecture arranged by Messrs. S. G. Brown, Ltd.

THURSDAY, DECEMBER 11th.

Royal Society of Arts. At 8 p.m. At John Street, Adelphi, W.C.2. Inaugural address of the 171st Session: "Radio Communications." By Senatore Guglielmo Marconi, G.C.V.O., LL.D., D.Sc., Chairman of the Council and a Vice-President of the Society.

Bournemouth and District Radio and Experimental Society. At 7 p.m. At Canford Hall, St. Peter's Road. Dutch sale of Members' Surplus Apparatus.

Luton Wireless Society. At 8 p.m. At Hitchin Road Boys' School. Experiments and Demonstration for Beginners.

West London Wireless and Experimental Association. At Belmont Road Schools. Lecture: "Measurement of Wireless Quantities." Part III. By Mr. F. E. Studt.

FRIDAY, DECEMBER 12th.

Bristol and District Radio Society. Annual General Meeting.

MONDAY, DECEMBER 15th.

Dorking and District Radio Society. At 7.45 p.m. At 65 South Street. Members' Evening with Apparatus.

TUESDAY, DECEMBER 16th.

Radio Association of Ireland. At 8 p.m. In the University College, Dublin. Lecture: "The Useful Valve." By Professor J. J. Dowling, M.A., F.Inst.P.

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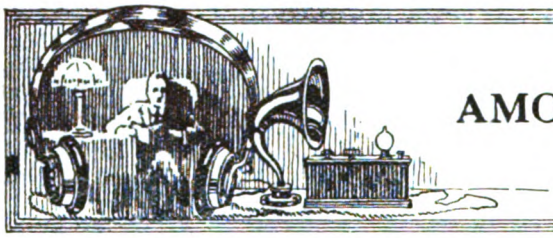

AMONG THE SOCIETIES.

The Woolwich Radio Society have produced another issue of their entertaining little magazine, "The Oscillograph." In perusing its columns the impression is gained that the Society is in a very active state, and the preparation of such a journal might well be considered by other societies.

* * * *

A lecture on electrical measuring instruments was given on November 19th before the Clapham Park Wireless and Scientific Society by Mr. E. F. Anderson, of the Cambridge Instrument Company. The many instruments dealt with included a moving coil tuner, galvanometers, ammeters and voltmeters, thermo-electric pyrometers, and many other devices specially designed for experimental work.

* * * *

On November 21st the Radio Experimental Society of Manchester held an instructive discussion on the neutrodyne method of H.F. amplification, the opener being Mr. J. Hudson. A lively discussion took place, and interesting demonstrations were made on a neutrodyne receiver, which proved the selectivity and ease of operation of which the circuit is capable.

* * * *

High and low frequency amplification were interestingly dealt with by Mr. John A. Sang, lecturing before the City of Belfast Y.M.C.A. Radio Club recently. The lecturer gave some useful information concerning the advantages and disadvantages of various methods of intervalve coupling.

* * * *

L.F. transformers were described by Mr. H. F. N. Riddle before the Croydon Wireless and Physical Society on November 11th. Of particular value was the lecturer's description of his method of winding transformers.

* * * *

Valve rectification was dealt with very thoroughly by Mr. B. A. Matthews in a recent lecture before the Birmingham Wireless Club. The value of the lecture was considerably enhanced by practical demonstrations carried out on the Club's detector panel.

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An informal lecture on "Esperanto" was delivered before the Tottenham Wireless Society on November 12th by Mr. Montagu C. Butler, Secretary of the British Esperanto Association. After outlining the difficulties of compiling a common language, the lecturer dealt with the reasons why a non-international language such as Esperanto is the best solution of the problem. He urged the advantages of its use in wireless communication.

At the following meeting of the society, Mr. F. J. A. Hall provided some interesting tests with a three-valve straight circuit, by means of which he demonstrated the value of adjusting the L.T. and H.T. voltages to suit different requirements.

* * * *

Members of the Glasgow and District Radio Society were entertained and instructed for over an hour on November 19th, when Captain P. P. Eckersley delivered a lecture on the work of the British Broadcasting Company. After dealing with the growth of the Company's system and the genesis of relay stations, Captain Eckersley spoke on the mysteries of fading. Some interesting and simple mechanical analogies were given and Captain Eckersley concluded with a tribute to the energies of Mr. J. C. W. Reith, Managing Director of the B.B.C.

* * * *

We note with regret the suspension of the Wandsworth Wireless Society, which was agreed to on November 21st. We trust that this is only a temporary measure and that the amateurs of such an important district as Wandsworth will again be represented in the near future.

Members of the Hounslow Wireless Society photographed on a recent field day with their portable transmitter.

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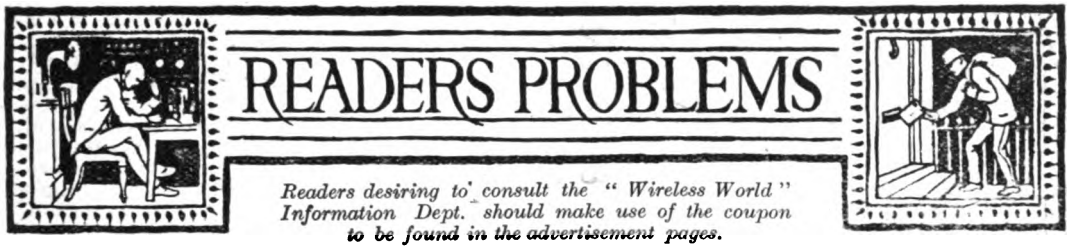

READERS PROBLEMS
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

A "ONE KNOB" RECEIVER FOR BROADCASTING.

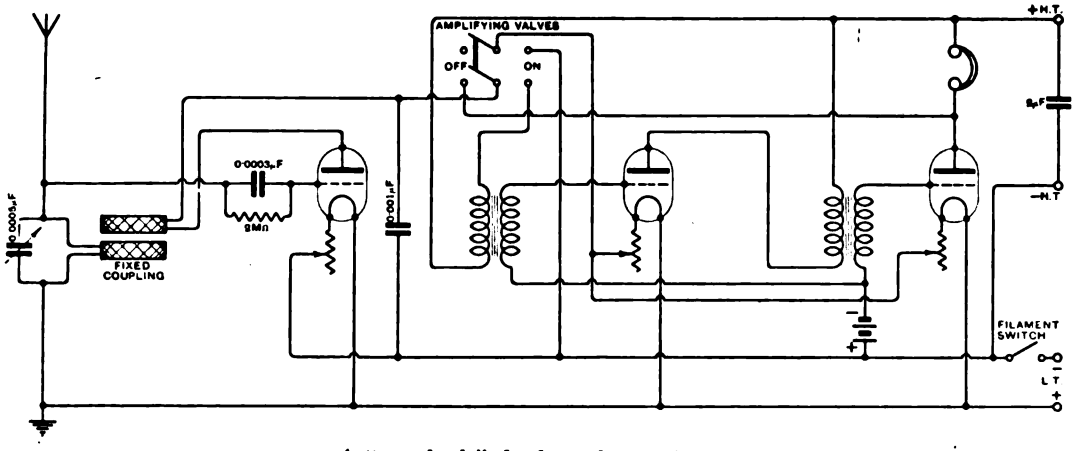
THE receiver given in the circuit diagram is controlled by a single tuning dial—that of the aerial tuning condenser. A detector valve provided with limited reaction is followed by two stages of low frequency amplification. Plug-in coils should be employed for the aerial and reaction circuits, with a fixed coupling between the coils. Two single coil holders may be screwed to the baseboard of the instrument parallel to one another, and about ½ in. or 1 in. apart. A suitable degree of reaction will then be obtained by carefully choosing the size of the reaction coil. This coil should be of such a size that the set does not oscillate at any point on the condenser scale. If pairs of coils are chosen in this way for different wavelength ranges, the use and adjustment of the set may be left to unskilled hands. A switch is provided to control the filament supply from the L.T. batteries, and a D.P.D.T. switch cuts out the last two valves when not required. Telephones or a loud speaker can therefore be connected across the output terminals according to the strength of signals required.

ANODE RECTIFICATION.

IN a wireless text-book a reader has noticed a circuit diagram in which no grid condenser and leak is used in the grid circuit of the detector valve. Instead, a variable negative grid bias is applied, either by means of grid cells, or grid cells in conjunction with a potentiometer. He asks in what manner rectification takes place, and whether this method is a desirable feature in a receiver designed purely for telephony.

The method of rectification referred to is generally known as "anode rectification," and depends for its action on the curvature of the lower end of the grid voltage—anode current characteristic of the valve. The method is inefficient for weak signals, but gives greater freedom from distortion than the grid condenser and leak method for telephony signals of large amplitude.

In special valves of the Q and QX type, the lower bend of the characteristic curve has been made to approach closer to the zero grid voltage line, and attempts have been made to increase the sharpness of the bend in the characteristic, with the object of improving rectification. In



A "one knob" loud speaker receiver.

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general, anode rectification should only be employed when several stages of H.F. amplification precede the detector valve, or when the receiver is situated very close to a broadcasting station.

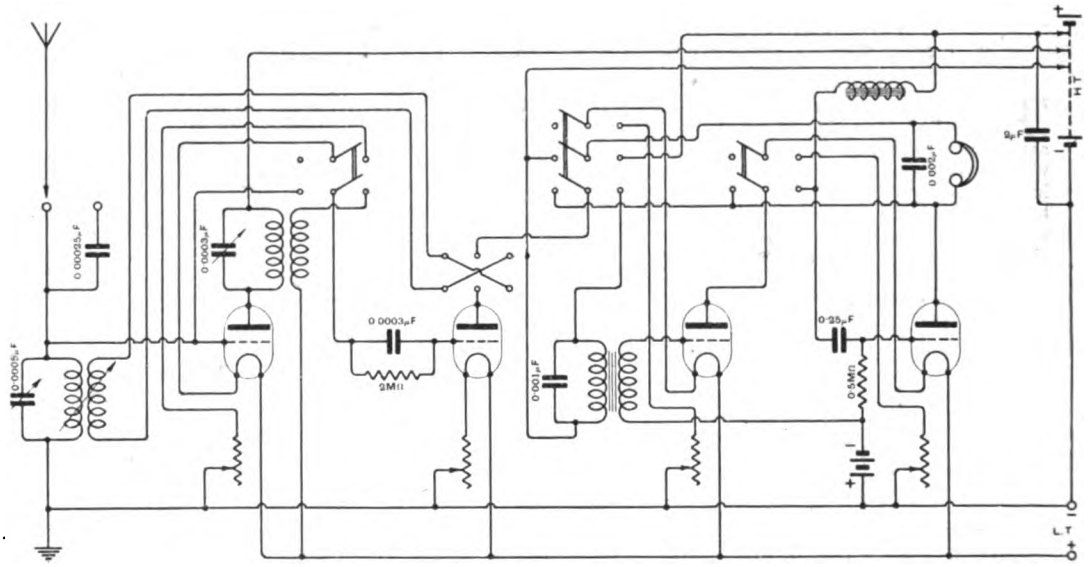
CONNECTIONS OF A FOUR-VALVE RECEIVER.

THE diagram given below shows the connections of a four-valve receiver with one stage of H.F. amplification and two note magnifiers. The H.F. valve is transformer coupled, and the first and second stages of L.F. amplification are transformer and choke coupled respectively. Switches are provided to control the number of valves in use, and separate H.T. voltages are applied to the H.F., detector and L.F. valves.

A COUNTERPOISE AERIAL.

A READER asks if there is any object in employing a counterpoise earth for transmission when the transmitting apparatus is already earthed through the power supply. In the particular case in point the D.C. power mains are used, in which the negative side is earthed.

On very short wavelengths the use of a counterpoise will certainly be found an advantage, even if the power mains are directly connected to earth. It is essential, however, to connect efficient high frequency choke coils in series with both power leads. The radio frequency portions of the circuit will therefore be isolated, and the counterpoise will function in an efficient manner.



A four-valve receiver with choke coupled power stage.

H.T. SUPPLY.

A READER who has a supply of current available from a 16-volt D.C. house lighting set wishes to raise the voltage to 120 volts for the H.T. supply, and asks if this could be done by means of a step-up transformer.

Before the transformer could be used, it would be necessary to interrupt the direct current by some mechanical means, and then to rectify and smooth the output from the transformer before it could be applied to the receiving apparatus. The necessary apparatus would be very costly and difficult to maintain, and considerable losses would be introduced. It would be much cheaper to purchase a small motor generator for the purpose, in view of the fact that dry batteries cannot be used, owing to the climatic conditions. Motor generators of this type, such as the M.L. Magneto Converter, have been designed specially for use in conjunction with receiving apparatus. They are extremely reliable, and will give very long service without attention.

RESONANCE IN A RESISTANCE COUPLED AMPLIFIER.

A READER who has recently constructed a resistance coupled low frequency amplifier observes that a very marked resonance peak is present in the lower frequencies.

One of the first things to be noticed in using a resistance coupled L.F. amplifier for the first time is the increased amplification given to the lower frequencies. It is possible that our correspondent has mistaken this quality for a resonance effect. Assuming, however, that this is not the case, and that true resonance is present, the most likely causes are to be found in the values of the grid coupling condenser and leak, and in the characteristics of the loud speaker itself. The latter is by far the most likely cause, and the possibility of resonance due to the time constant of the grid condenser and leak can be detected by changing one or other of the values. and observing whether any change is thereby brought about in the frequency of resonance.

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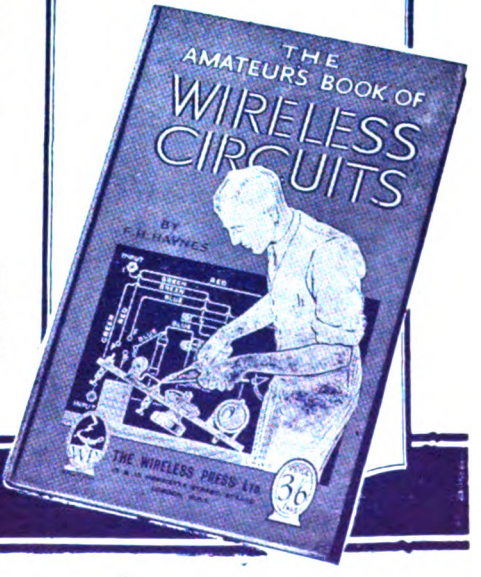

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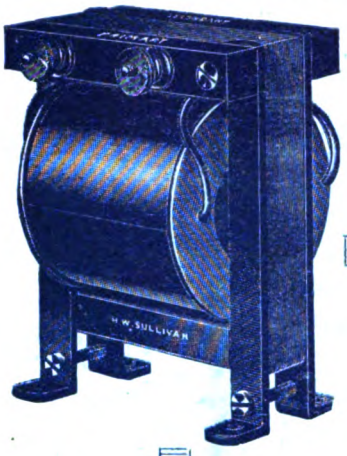

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THE WIRELESS WORLD AND RADIO REVIEW

PRICE 4D NET.

JAN 7 1925

LOUD SPEAKERS

BY

CAPTAIN ROUND

OF THE UNIVERSITY OF

No. 279 [No. 12 Vol. XV]

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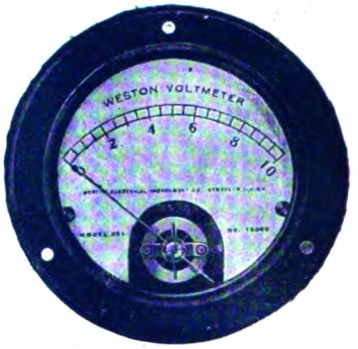

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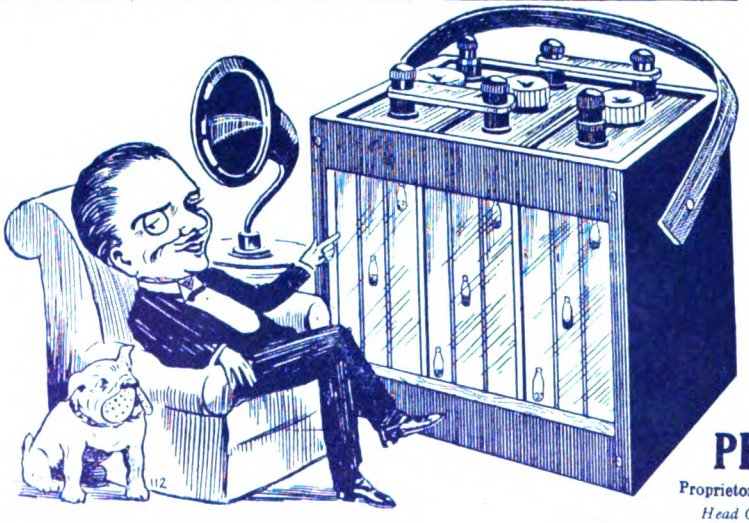

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

AMERICAN NATIONAL CONFERENCE REPORT.

By the Editor.

A REPORT on the recommendations for the regulation of radio adopted by the Third National Radio Conference has just been issued. This Conference has for the past three years been called by the Secretary of Commerce of the United States of America and the present report is a document of vital interest to everyone associated with wireless, and in particular the amateur.

In reading through the publication we have been struck by the large amount of attention which has been paid to the requirements of amateurs as users of wireless and the very generous consideration which has been given to their needs. The Secretary of Commerce, opening the Conference, in referring to those present, stated, "You who represent the radio fans, broadcasting stations, engineers and manufacturers, have come at my request to again consider the situation from a national point of view and to determine what steps can be taken to advance the art and improve its service." Whether by accident or design, it is of interest to note that the amateurs or radio fans are addressed first in the classification of wireless interests, and the same consideration is noticeable throughout the recommendations of the Conference. In dealing specifically with the interests of the amateur, the Secretary of Commerce went on to state:

"Nor have we overlooked in these previous conferences the voice or interest of the amateur, embracing as he does that most beloved party in the United States—the American boy. He is represented at this conference, and we must have a peculiar affection for his rights and interests. I know nothing that has contributed more to sane joy and definite instruction than has radio. Through it the American boy to-day knows more about electricity and its usefulness than all of the grown-ups of the last generation. I have during the past year somewhat extended this wave band. I hope that this conference may dismiss the objections that have been raised to this action."

In the final recommendations under the heading of "Amateurs," the wording is as follows:

"The Conference has allocated to amateurs substantially the same frequency bands that are now in use, with some minor changes in their location. The temporary allocation of frequencies above 2,000 kilocycles (below 150 metres) made by the department to the amateurs some months ago is given definite approval with some slight changes in the bands. The net result of this is to give to amateurs an increase over what they had at the end of the Conference a year ago, and to allow them a much greater area for operation."

This expression of opinion made by the United States Secretary of Commerce and the final recommendation of the Conference shows clearly how completely the work of the amateur is recognised and valued by the American public as represented by all wireless interests. As indicating the consideration which is given to the amateur, a further quotation may be taken from the speech of the Chairman. In dealing with the subject of interference he states:

"Our amateurs, who make up by far the largest element in the radio family outside of the listeners as a whole, are particular sufferers, since the harmonics from many stations have an especial tendency to invade the amateur band. Accurate and sharp transmission must be insisted upon."

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Various sub-committees were appointed to report to the Conference, and No. 5 of these was detailed to consider amateur problems. The following is a copy of their report to the Conference: "Sub-committee No. 5, amateur problems, has met, and, being advised of the allocation of frequencies for amateur use by sub-committee No. 1, has considered amateur problems involving subdivision of types of transmitting apparatus and also various amateur technical problems. We have found that most of the problems confronting the amateur are disciplinary in character, and can best be handled within the amateur organisation with the assistance of the chief supervisor of radio. The committee has voted unanimously to recommend to the Conference the following:

1. That the use of receivers capable of radiating be discouraged for use on the short wave relay broadcast bands.

2. Except in the case of transmitters using coil antennas or loops, the use of circuits loosely coupled to the radiating system, or devices producing an equivalent effect, shall be required in all amateur transmitters.

3. All of the amateur bands shall be open to telegraphic communication effected by means of tube transmitters or devices producing an equivalent effect, excepting those using outright forms of I.C.W. by mechanically interrupting one of the radio-frequency circuits.

4. A band of 1,670 to 1,760 kilocycles (170 to 180 metres) shall be assigned non-exclusively to amateur radiotelephones and I.C.W. stations which employ apparatus in which one of the radio-frequency circuits is mechanically interrupted.

5. The question of issuing one amateur station licence which will permit of the use of all amateur wavebands is to be left to the discretion of the chief supervisor of radio.

6. The international intermediates that have been in use by the amateurs of the various nations in their international amateur radio communications, and which were established unofficially by the American Radio Relay League should be continued, and it is requested that this matter be taken up by the Department of Commerce with the International Bureau at Berne to the end that they may be brought to the attention of the next International Radiotelegraphic Convention for official confirmation."

The tendency in the past has been for most radio-telegraphic regulations, where they apply to individual countries, to be based on decisions arrived at at international conferences. It is therefore not unreasonable to expect that regulations framed by the United States for the control of wireless in that country are likely to be followed by many other nations.

Unfortunately there are still some countries in Europe where amateur transmissions are unauthorised. Notably we may refer to Denmark, where we understand that the regulations are so stringent that an unfortunate amateur who passed to *The Wireless World*, for publication, some particulars of his transmissions, has been traced, and his apparatus confiscated by the authorities as a sequel. Happily, in this country we are for the moment less subject to oppression and individual rights of citizens are still respected. There are, however, rumours of trouble to come, and we must expect that attempts will be made in the near future to divest the amateur of facilities for experimental work as a right, and he will be placed in the position of having to plead for facilities, and be at the mercy of individuals whose task it is to administer the law in relation to the granting of experimental licenses. Amateurs in this country must wake up, and the public too will have to be educated to appreciate the value of the amateur until the same consideration is given as the recent Conference indicates, is granted in the United States. When we consider that this Conference in America relates only to problems of transmitting stations, one realises even more how unsatisfactory are the conditions under which the amateur operates in this country. In America the necessity does not exist for any licence for reception. Our readers are equally as familiar as we ourselves with the position here of those who desire to conduct experiments in transmission, and they can draw for themselves the comparison between the attitude of the authorities here and in America. It is up to every amateur to do what he can to bring the public, and particularly those individuals who may have influence with the Government, to understand something of the value of the work of the amateur, and acquaint them with the fact that in this country, where our boast has always been the Freedom of the Subject, we are far behind our more progressive friends in the United States.

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LOUD SPEAKERS

In the issue of November 26th Captain Round described the microphone and associated amplifiers now in extensive use for broadcasting and reproduction of band music, speech, etc. In the present article the author gives details of his loud speaker and associated equipment which may be regarded as a companion to the microphone system.

By CAPTAIN H. J. ROUND, M.I.E.E.
Chief of Research Department of the Marconi Company.

THE Marconi Microphone Amplifier system described in a recent issue (see issue of Nov. 26, 1924), pages 260-265, lent itself to a rather elaborate but very high quality public speech amplifier and general amplifier for bands and other types of music.

The only additions necessary were some form of power amplifier and a loud speaker capable of handling music and speech, The practical development of these details was started about a year ago and a considerable number of sets have been in common use for some months.

The power amplifiers were built up by using parallel valves with very open grid mesh so as to enable considerable power to be developed with comparatively low plate voltage. In this way storage batteries could be used for the source of power.

A standard power amplifier using 8 open mesh L.S.5 A valves is shown in Fig. 1, and this is connected directly to the "B" amplifier shown in the previous article.

Fig. 2 is the diagram of connections for this instrument.

Two commercial sizes of large loud speakers have been designed to work with this amplifier, but the principle employed in the loud speaker lends itself to practically unlimited increase in size and power if necessary.

The basic idea in the loud speaker is that invented by Sir Oliver Lodge and consists of a suspended cylindrical coil immersed in a strong magnetic field. The field is energised with direct current and the speech current traverses the coil. This principle is well known in the Magnavox but unlike that instrument a normal type diaphragm is not used.

A cylindrical coil C Fig. 3 is rigidly connected to a narrow annular strip which is made of such a width that it moves only as a whole. The edges of the strip both

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inside and outside are connected with the general body of the magneto system and an elastic membrane, MM.

The coil C is immersed in a magnetic field produced by a magnetic system, X.

The whole system can be given any one natura period, which I have found it preferable to have between 150 and 250 per sec. for practical reasons.

tone of music although it will be quite satisfactory for speech.

A diagrammatic section through the magnetic system of one of the loud speakers is shown in Fig. 3. It is possible to use this type of instrument without horns but for general public work the horn has many advantages. The smaller commercial type of instrument is shown in section with its

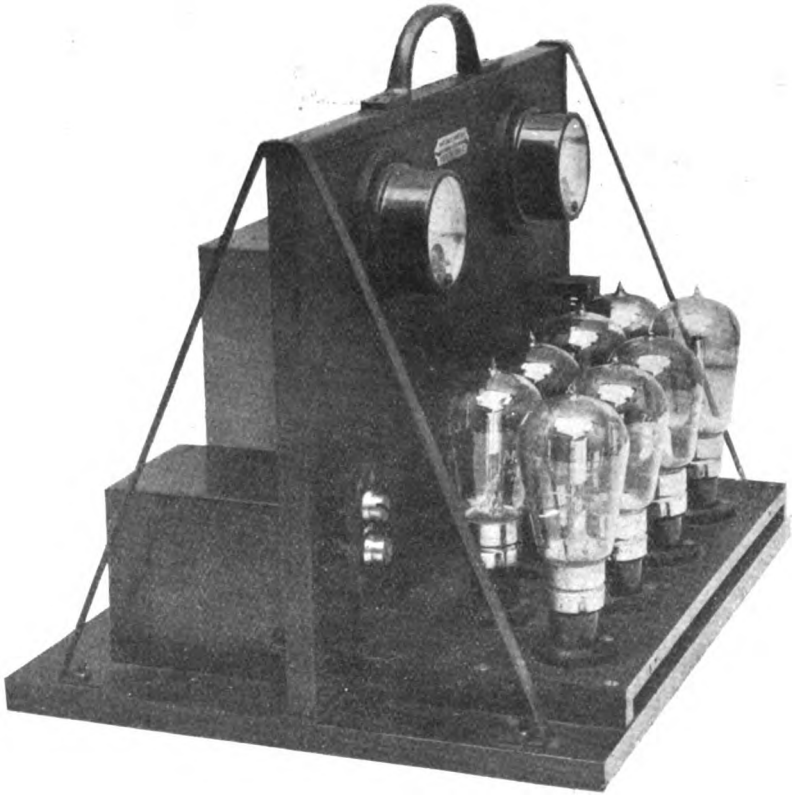

Fig. 1. The "C" Amplifier with eight L.S.5A valves in parallel.

Too low a period permits serious rattling of the diaphragm on the pole pieces. Too high a period tends to reduce the lower

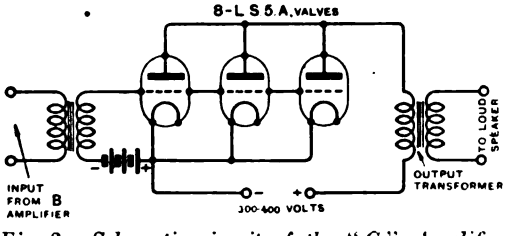

Fig. 2. Schematic circuit of the "C" Amplifier.

horn, Fig. 4, and a photograph of the base parts in Fig. 5.

Fig. 6 is a photograph of the base parts of the large loud speaker showing the magnetic system, the diaphragm, the central core for the air chamber and the base of the horn.

The large loud speaker on its stand is shown on the previous page.

The magnetic system in the larger type consumes 4 amperes at 6 volts and a field of 9,000 lines per square centimetre is produced across the gap.

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The moving coil has a resistance of 9 ohms —and will carry for some considerable time

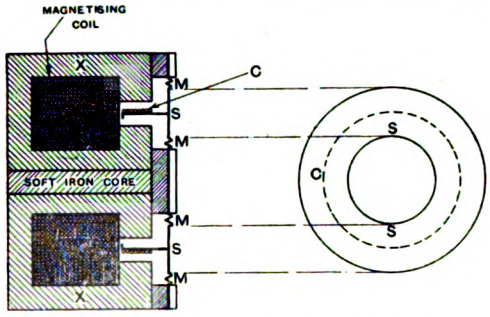

Fig. 3. A diagrammatic section through one of the loud speakers (not to scale).

± 2 millimetres, and consequently the moving coil system has to be constructed very strongly. In the design work the longest time was taken in making a satisfactory diaphragm.

The connections to the winding gave a great deal of trouble on account of the continual bending, but all these difficulties have now been completely overcome.

The output transformer of the amplifier is arranged with tappings to permit of several loud speakers being connected if necessary, in each arrangement with the correct terminal condition. It is now usual to have a transformer with each loud speaker to permit of a high impedance line being used with it, so

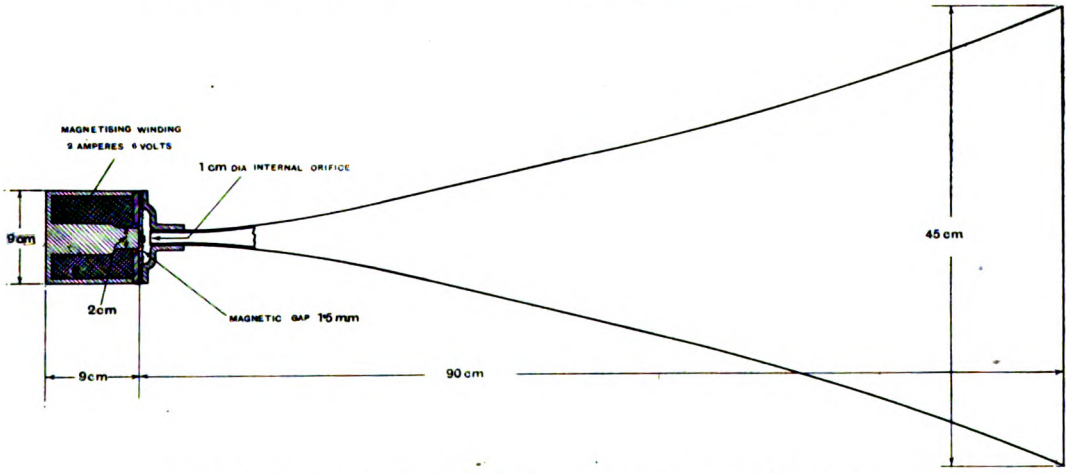

Fig. 4. A dimensional sketch of the small type commercial loud speaker.

one ampere of alternating current—about 10 watts.

The amplitude of movement of the diaphragm system can be as much as

that long leads up to a mile or so may be employed if necessary.

The large system described above is suitable for very big demonstrations and is

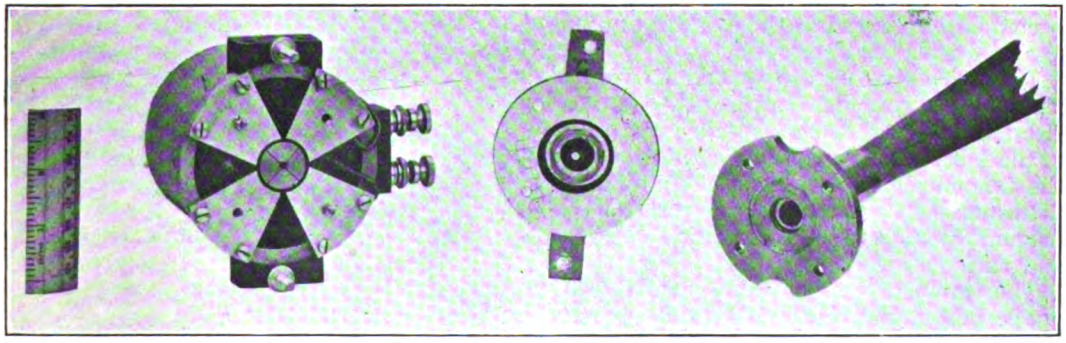

Fig. 5. Detailed photograph of the base parts of the smaller loud speaker, showing the magnetic system, the diaphragm and the horn base.

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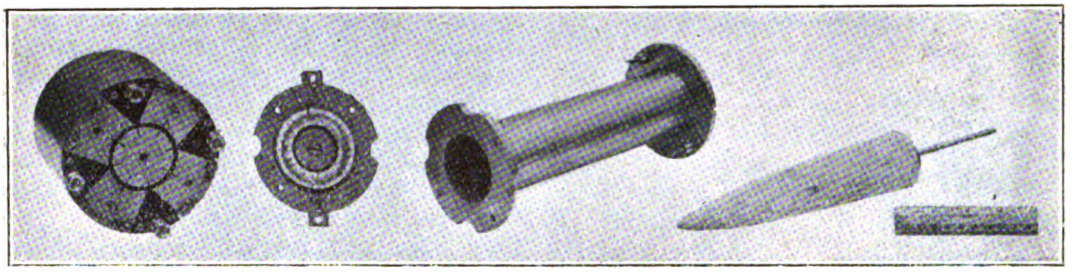

Fig. 6. Base parts of the large loud speaker showing the magnetic system, diaphragm, outer tube of horn base, and inner cone.

necessarily expensive both initially and to maintain. A smaller system has been produced which will be described in these pages shortly. In this system both the initial

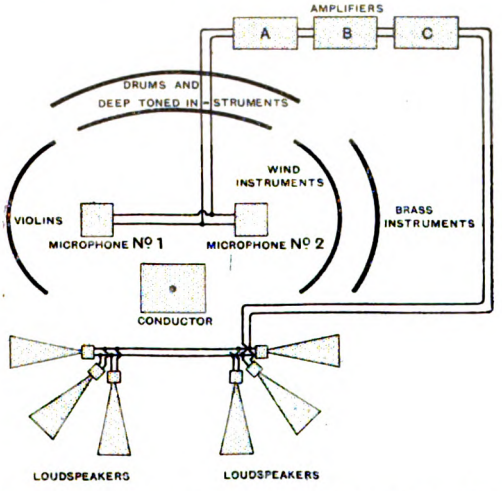

Fig. 7. A plan to indicate the best distribution of microphones and band instruments.

expense and the maintenance costs have been greatly reduced at the expense of some loss of quality and strength.

I will now give one or two examples of the use of the complete apparatus. On the election night a demonstration was given at the Albert Hall for the *Daily Mail*, at which the announcing of election result alternated with amplified gramophone records and the magnification of the Piccadilly Orchestra and various singers.

The announcements were made from another room and this problem exhibited no difficulties, but to amplify an orchestra was not quite so easy.

The difficulty of all public speech work when the microphone is near the loud speaker system is reaction—that is the sound from the loud speaker gets back to the microphone and eventually at some magnification the whole system howls.

It is easy to see that this effect will be worse in a hall with echo. The actual strength from the loud speaker which can be produced is inversely as the distance of the original sound from the microphone.

Now with an orchestra it is very difficult to get near every instrument with one microphone and a number will have to be

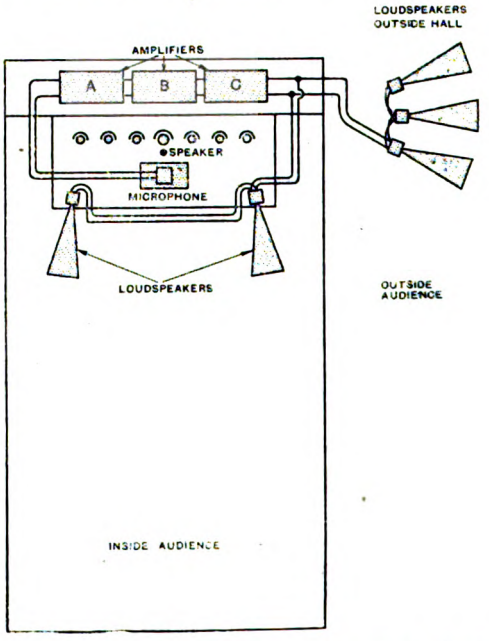

Fig. 8. Plan showing how the apparatus should be arranged so that a speaker in a hall may address two audiences at once.

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used to give the right effect. The actual arrangement used is shown in Fig. 7, where there are two microphones, one for the violins, one for the wind instruments and brass instruments, whilst the other big instruments take care of themselves. By adjusting the magnetising currents of each microphone a correct balance is obtained and a very large amplification of the band is produced without any serious disturbance of the normal distribution of the orchestra.

It will be noted that the microphones are always put at the back of the loud speakers. The horn of the loud speaker tends to give a marked shadow at the back, thus reducing the tendency to reaction.

Another condition which occurred frequently during election time was the amplification of the speaker's voice in a hall and the transmission of the voice to overflow audiences outside. The arrangement employed is illustrated in Fig. 8. Actually the outside loud speaker can be used at full strength as there is little tendency to reaction, since they are shielded from the microphone, but the inside loud speakers shunted on to these outside ones are controlled with a series rheostat and brought up to the strength the system will stand, *i.e.*, nearly up to the howling point. Occasionally, in certain halls, under these conditions, when packed with people, no reaction trouble was shown, but in this case another curious trouble was experienced. As the microphone and speaker were both in a strong sound shadow, the speaker did not instinctively realise how powerful his voice was against interruption, and so did not use that power to the full.

A technical solution of the difficulty is to give the speaker headphones shunted on to the loud speaker, but the practical solution is to instruct the speaker to go ahead and find out by the effect of his speech on the audience how strong his voice is.

A GERMAN BROADCASTING PLANT.

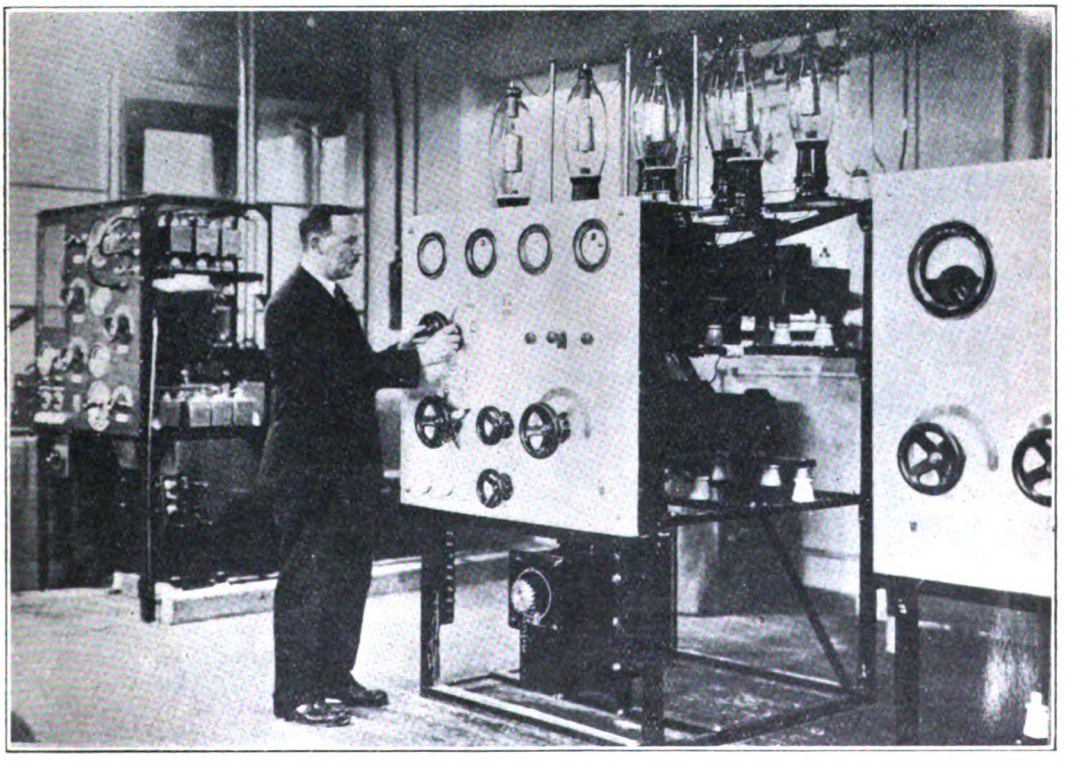

Photo: Photopress.

A view in the transmitting room of broadcasting station installed at the recent Berlin Wireless Exhibition. The station may remain in permanent use.

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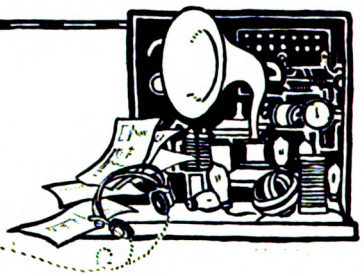
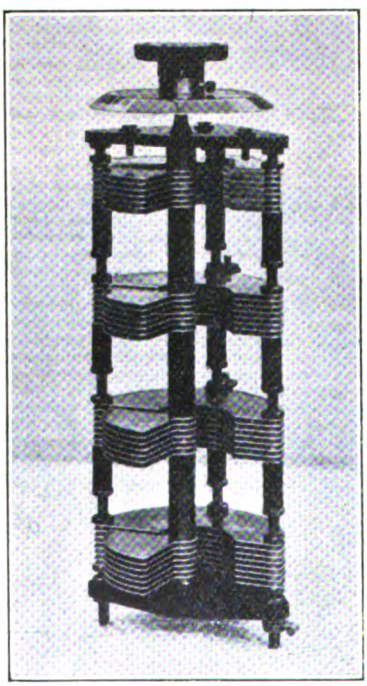
NEW APPLIANCES.



The Bowyer-Lowe Quadruple Condenser.

Multiple condensers consisting of sections controlled by the movement of a single knob and dial have many applications. When the sections are exactly equal in capacity value throughout the entire range such condensers are occasionally employed

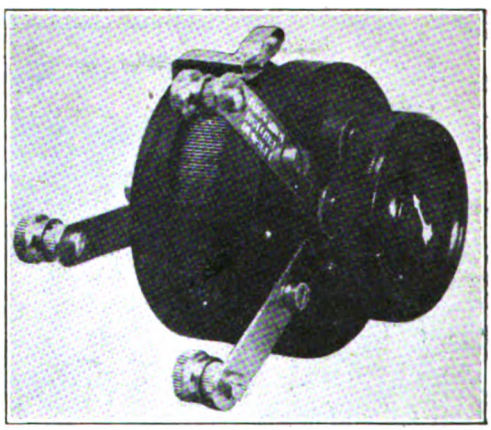


The four-section condenser, a product of Bowyer-Lowe.

for simultaneously tuning a number of oscillatory circuits, whilst sometimes this arrangement is adopted for uniformly controlling self-oscillation. The somewhat unique condenser shown here may be found to have many useful applications in experimental work.

The Ediswan Potentiometer.

The resistance wire, which has a value of approximately 300 ohms, is wound on a fibre strip held firmly in position between two circular end pieces. Reliable contact with the resistance wire is made by means of a brush attached to the end of the rotating arm and owing to its special shape has a particularly smooth action.



The Edison Swan Electric Co.'s potentiometer.

A New Square Law Condenser.

The Edison Swan Electric Co., Ltd., have recently introduced a condenser of the square law type. It is robust in construction, having its plates made of hard brass and nickel plated. The end pieces are made of thick insulating material of sufficient strength to overcome any chance of bending. Tapped holes are made at the sides of the end plates to allow for mounting the condenser on a baseboard, a particularly useful feature which has not been overlooked. The condenser has quite a good movement and it is with some satisfaction we observe

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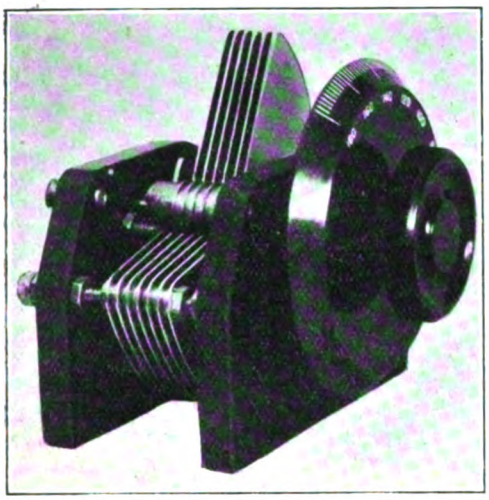
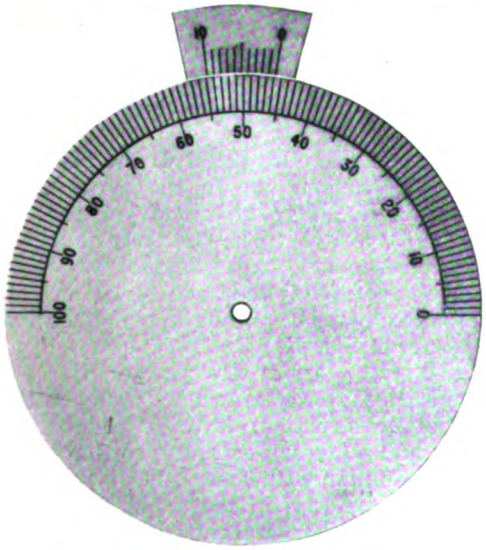


Ediswan's new square law condenser.

that the spindle makes a good fit in the bushes carried by the end plates. It is made up in three sizes, having capacities of 0·0003, 0·0005 and 0·001 microfarads.

A Vernier Scale.

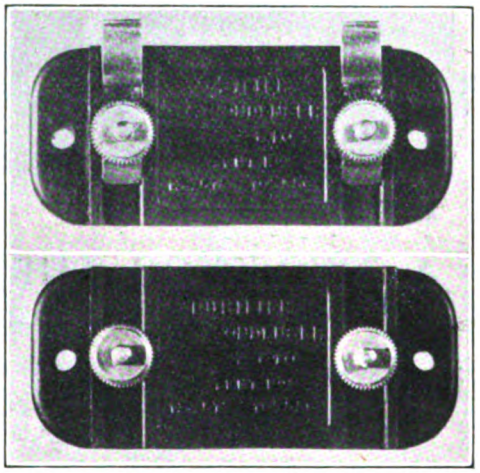
To facilitate accurate reading of variable condenser settings a vernier dial has been introduced by Messrs. N. V. Webber. The dial itself is of good stiff ivorine and is divided into a hundred sections. The fine reading attachment has a suitably curved edge so that it fits well against the edge of the dial and by means of its use tenths of a division can be rapidly read off. This dial should prove exceedingly useful if fitted to a wavemeter when it is necessary to read to fractions of a scale division.



A vernier dial made in ivorine. Used on a wavemeter it provides easy reading to the $\frac{1}{10}$ of a scale division.

The New Dubilier Fixed Condensers.

The Dubilier Condenser Co. are now marketing small fixed condensers suitable as grid and blocking condensers, having a somewhat different finish to the well-known 600 and 600A types. These condensers are a little larger in dimensions, whilst a new moulding material is used having a particularly clean appearance. The type intended for use as a grid condenser is fitted with milled terminals and clips can be fitted if required so that the leak can be mounted across it.



The new Dubilier Type 610 condenser with detachable clips.

Another new product of the Dubilier Co. Condenser Type 620.

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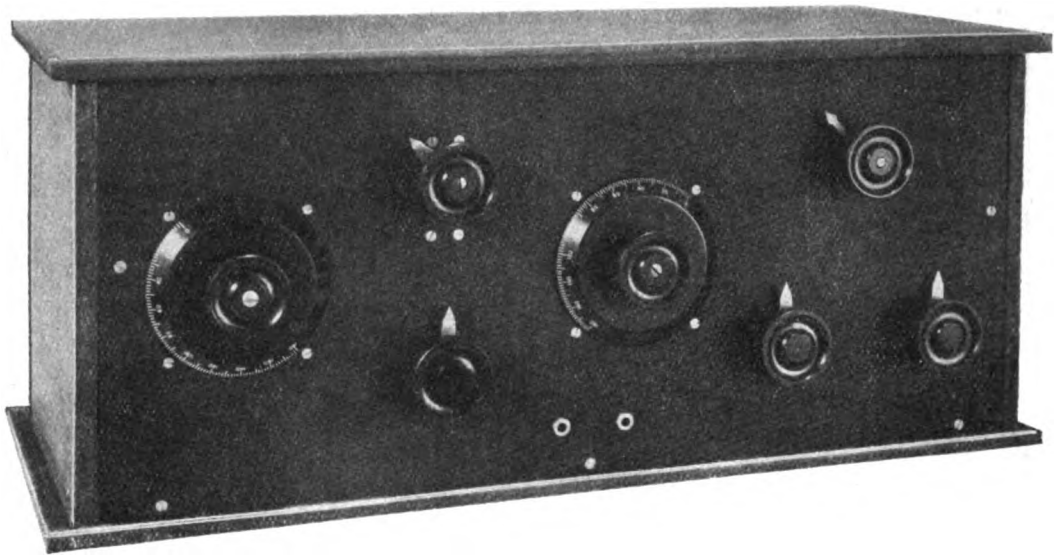

A TWO-KNOB THREE VALVE RECEIVER

TUNING FROM 250—2,800 METRES.

The set described in this article has been designed for extremely simple tuning over all broadcasting wavelengths. Only two tuning controls are provided and the settings of these are made to correspond so nearly that ease in tuning is assured.

By HUGH S. POCOCK.

THE three-valve receiver to be described in this article may conveniently be referred to as a "two-knob set," not because there are only two knobs, for the photograph shows that there are seven, but because all the tuning can be done by means of the two knobs which carry dials. The range in wavelengths of the set is approximately from 250 to 2,800 metres, so that all the broadcasting stations of the British Broadcasting Company, as well as the Continental broadcasting stations, are included.

Those who are interested in the reception of broadcasting stations and who customarily use the very popular types of receivers where plug-in coils are employed, find that it is very tiresome to have to change several coils in order to go over from the local station to 5 XX or *vice versa*, and the two independent programmes now being transmitted make it still more desirable to be able to change over rapidly from one wavelength to another. This was the principal consideration in the design of this receiver. It is possible to receive the local station or 5 XX at will, and to change over from one to the other almost instantaneously without any other adjustments except the movement of the switch between the two dials and the readjustment of these two for the new wavelength.

The two dials are fitted to the spindle of two variometers, one in the aerial circuit and one in the plate circuit of the high frequency valve. The set consists of one high frequency stage (anode variometer tuned), detector, and one stage of L.F. amplification. The circuit in simplified form is given in Fig. 1.

The two variometers are of the type supplied by Sterling's, which, owing to their special construction, have a wide tuning range and a low self-capacity, so that tuning is sharper than with some other types. The first variometer is in the aerial circuit, and therefore has the aerial capacity permanently in parallel with it. In order that the setting of the two dials may be approximately the same, for the sake of ease of adjustment, a

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fixed condenser is arranged to be in circuit in parallel with the anode variometer on all wavelengths, and the value for this is chosen as 0·0002 μF, which is assumed to be the capacity of the average aerial when a 0·0005μF condenser is in series with the aerial.

The next consideration was to arrange for obtaining the requisite tuning range without complicated switching or wiring.

LONG WAVES.

For the longer waves the windings of the variometers remain as for the medium range, but two fixed condensers each of 0·0005 μF are inserted in parallel with the windings of each variometer. The aerial capacity compensating condenser is also left in parallel with the anode variometer, whilst the 0·0005 μF condenser across the aerial variometer is that which in the other positions

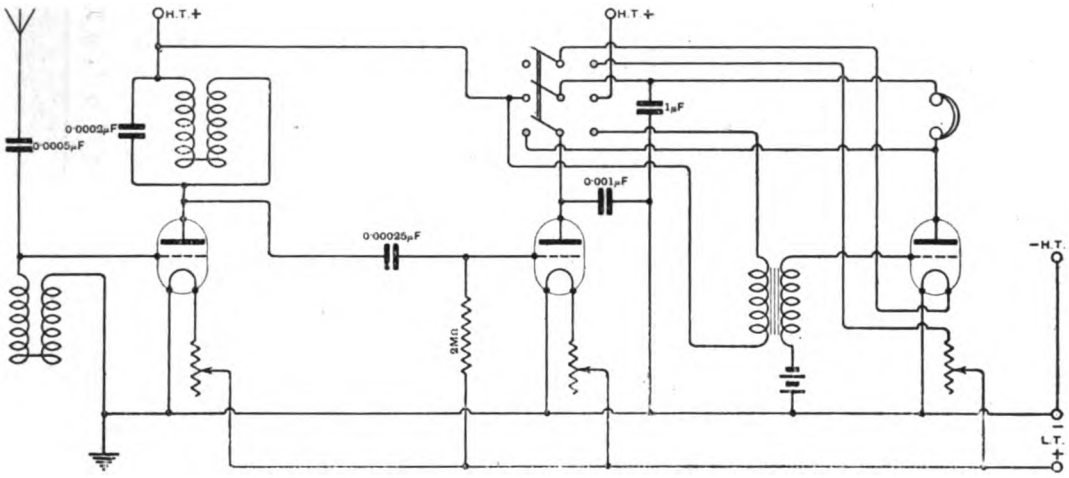

Fig. 1. Diagram of the circuit employed.

SHORT WAVELENGTHS.

For the short wavelengths the windings of each variometer are required to be in parallel, so reducing the inductance values. The aerial compensating condenser is included across the anode variometer, and a fixed condenser of value 0·0005 μF is inserted in series with the aerial lead (Fig. 2 position 1). In this way one is starting the tuning range at the minimum of the variometer, which is approximately 250 metres.

MEDIUM RANGE.

For the medium wavelengths the inductance of the variometers is increased by arranging the windings of the stators and rotors in series, and the tuning ranges as indicated by the two dial settings are brought to approximately the same by introducing again the aerial compensating condenser referred to above across the anode variometer, and leaving the series fixed condenser in the aerial circuit (see Fig. 2, position 2).

was in series with the aerial (see Fig. 2, position 3).

It might at first appear that in order to obtain these various conditions for three different ranges the switching arrangements would be exceedingly complicated. This, however, is not the case, and although considerable thought had to be given to working out how it could be done in the first instance there is no great difficulty to be encountered in arranging the switching when it is set out as in the accompanying illustrations. All the necessary circuit arrangements can be done on one barrel switch, and for this receiver a five-contact barrel switch of Sterling type has been chosen. The three ranges of wavelength (Fig. 2) are made with three positions of the switch, and since the connections to the switch are the only real difficulties in constructing the set these are explained in considerable detail in the drawings. First of all the barrel of the switch, which is of ebonite, will be found to be supplied with a number of round-headed

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screws, and these have to be screwed out in places and inserted in other holes provided, as is clearly indicated in Fig. 3. These screw heads have no connections to them, but

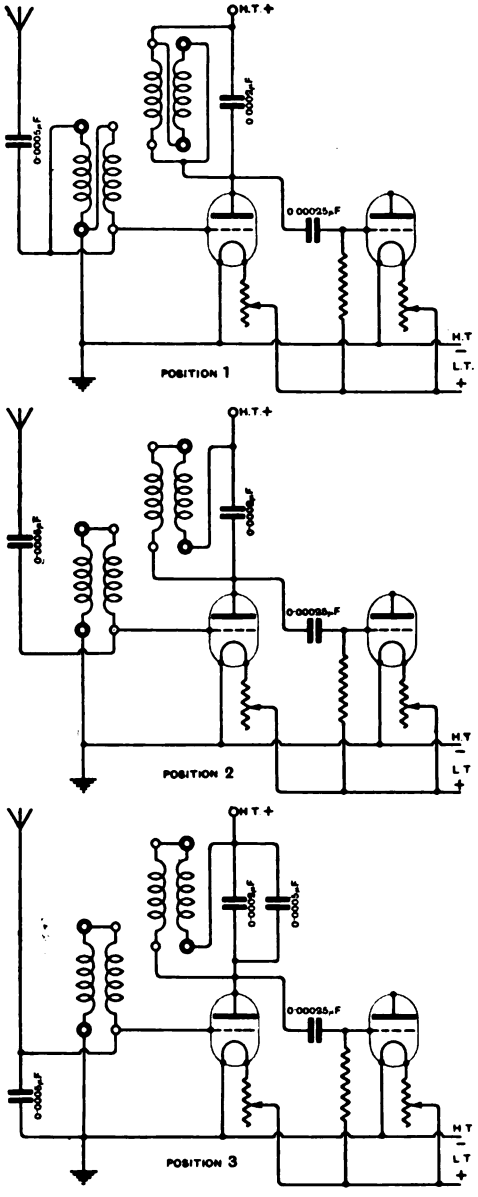

Fig. 2. Showing the circuit arrangement in the three positions of the barrel switch.

merely serve to bring together the contact blades of the switch where connection is required to be made. Having arranged the screws in the correct position as indicated in Fig. 3, the next step should be to solder all the strap connections of the switch, as shown in Fig. 4, because whilst it is easy to do

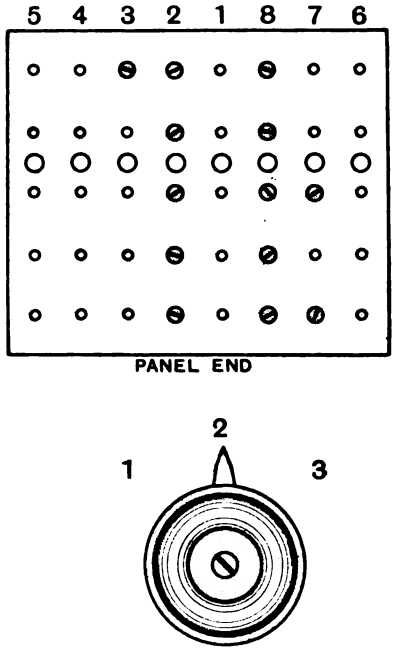

Fig. 3. Showing where the screws should be inserted in the barrel.

this when the switch can be handled freely, it would be an extremely difficult job to undertake after the switch had been fitted to the panel. My own view is that it is always more convenient when working from a definite and dimensioned design to

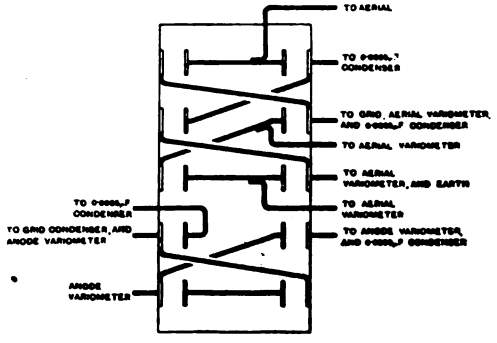

Fig. 4. Strap connections of the barrel switch which should be made before the switch is mounted on the panel.

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do as much as possible of the soldering of connections before the components are mounted, because, in proportion to the number of components fitted to the panel, so the inaccessibility of different points to be soldered becomes greater. Next, as many of the remaining leads from the switch very carefully checked over, because to find after all the wiring had been done that a wrong connection on the switch had been made would be more than exasperating, because of the difficulty of getting at the connections afterwards.

It may be thought that it is rather out of

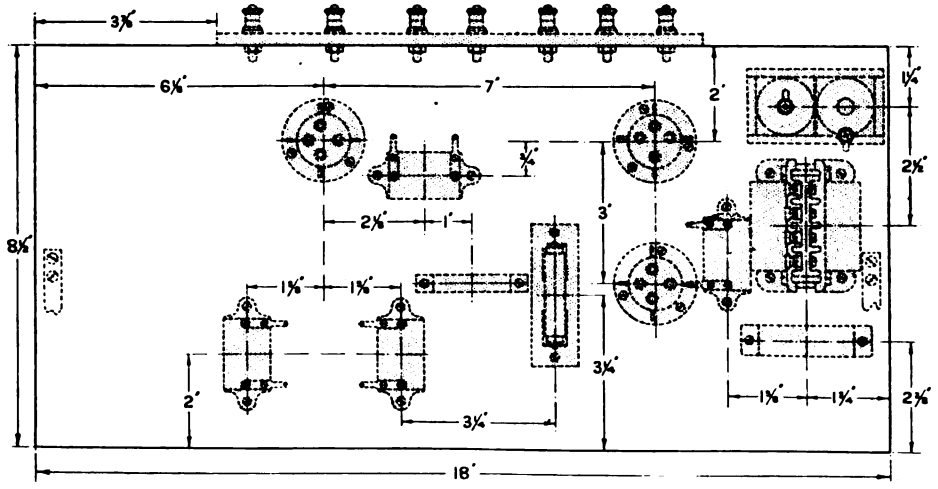

Fig. 5. The lay-out of components on the base.

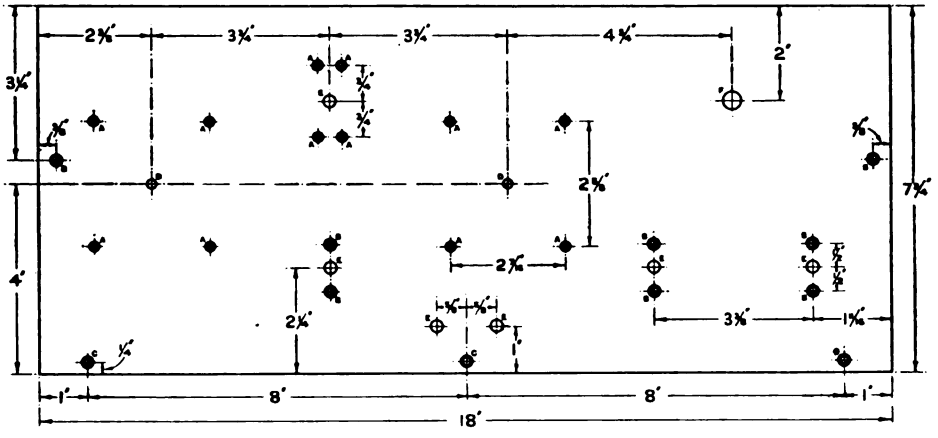

Fig. 6. Diagram for panel drilling. Dimensions for holes are as follows :—A, ⅛" dia. countersunk for No. 6. B.A. screws. B, $\frac{5}{32}$" dia. countersunk for No. 4. B.A. screws. C, ⅛" dia. countersunk for No. 4 wood screws. D, $\frac{7}{32}$ dia. E, ¼" F, ⅜" dia.

as possible may be soldered, giving consideration to the requisite length and direction of the various leads to the points of attachment to other apparatus. The utmost care must be taken to see that all the switch connections are correctly made, and this part of the work should be order to discuss the wiring of a component before dealing with other parts of the set, but the reason the switch is taken first is because, as stated above, it comprises the hardest part of the construction, and once that has been understood correctly the rest is " plain sailing."

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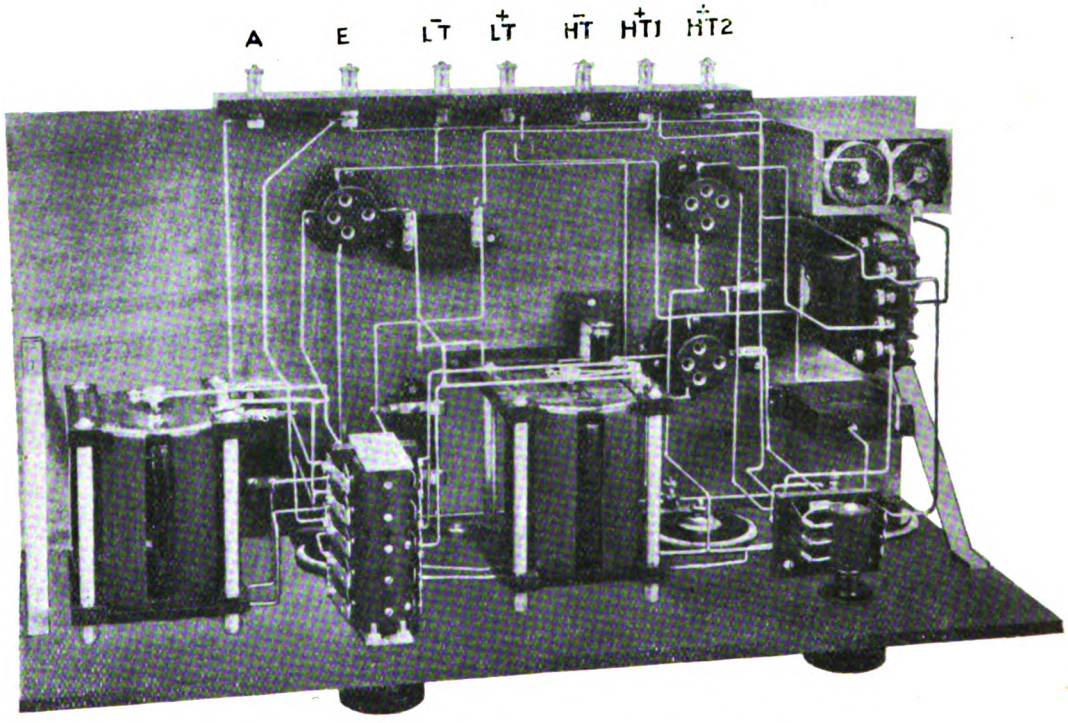

A photograph showing details of the layout and wiring of the components.

It will be noticed from the layout of the base (Fig. 5), that the spacing of the components had been rather on the generous side. This is partly because, in my opinion, it is seldom worth while to cramp components and thereby add considerably to the work of construction, and especially wiring with only a small gain in appearance; but the principal reason is that it was necessary to provide reasonable spacing between the variometers in order to avoid coupling between them. If they were brought closer together they would couple in some positions of the rotors, and not in others, resulting in very unsatisfactory operation of the receiver, and screening would have to be resorted to as a compromise remedy.

In Fig. 6 is given the dimensions of the ebonite panel, with positions and dimensions of holes to be drilled to accommodate the components used in the receiver.

If any other components are made use of as alternatives the reader must ascertain the correct holes and positions for them. A complete list of the parts used in this set is as follows:—

Ebonite panel, 18 ins. by 7¾ ins.
2 Sterling variometers.
1 Sterling barrel switch, type R 2837.
1 Igranic L.F. transformer, ratio 3 to 1.
3 Ormond filament resistances.
3 Burndept valve holders.
1 ,, grid leak, 2 megohms.
Dubilier fixed condensers of the following values: 0·00025, 0·0002, 0·001 and two of 0·0005.
1 Fixed condenser, 1 microfarad.
1 Utility three-pole two-way switch
1 Two-cell grid bias battery.
7 Terminals.
2 Plugs and sockets for telephones.
1 Wood base, size 18 ins. by 8½ ins. by ⅜ ins.
2 Brass brackets.

(To be concluded.)

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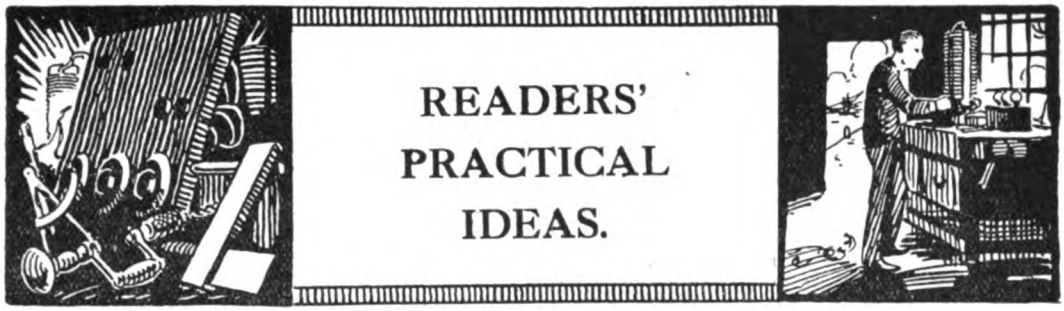
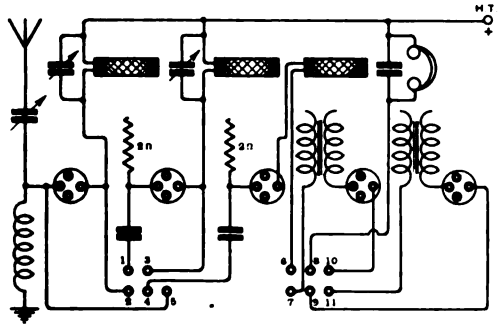


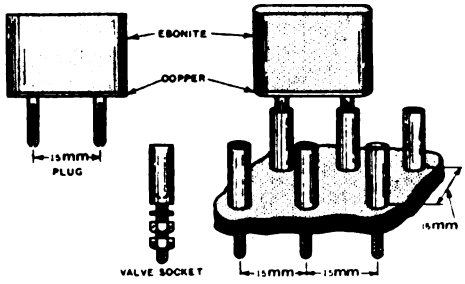
This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

A Simple Switch for Valve Amplifying Stages.

THE use of pin and socket connectors for switching purposes is often adopted by amateurs in the design of their sets and the circuit layout shown here has been developed so that valves may be thrown in and out of circuit efficiently and without the use of expensive multi-contact switches. Bridging connectors are made up from pieces of ebonite and pairs of valve pins. Five of these are inserted in a set of five and another set of six valve sockets. The method of connecting these sockets in the circuit is shown and for simplicity the filament leads are omitted. The following connections provide for using any arrangement of valves from one to five. With sockets 4 and 5 and 6 and 8 bridged the set is a single valve detector, 4 and 5, 6 and 7, and 8 and 10 bridged gives detector valve with one note magnifier. With 4 to 5, 6 to 7, 8 to 9, and 10 to 11 gives detector valve with two note magnifiers ; 2 to 4, and 6 to 8, gives one high frequency amplifier with valve detector ; 2 to 4, 6 to 7 and 8 to 10 gives one H.F., detector and one L.F ; 2 to 4, 6 to 7, 8 to 9 and 10 to 11 gives one H.F., detector and two L.F ; 1 to 2, 3 to 4, and 6 to 8 gives two H.F. and valve detector ; 1 to 2, 3 to 4, 6 to 7 and 8 to 10 gives two H.F., detector and one L.F ; 1 to 2, 3 to 4, 6 to 7, 8 to 9, 10 to 11 gives two H.F., detector and 2 L.F.



Circuit connections of sockets numbered 1 to 11, into which bridging pieces are inserted for changing the number of valves in circuit. The diagram has been simplified by omitting the L.T. battery leads.



Details of the bridging pieces.

L. V.

Another Variable Grid Leak.

ONE disadvantage possessed by many of the types of variable grid leak available is that they are not fitted with an indicator showing to some extent the value of the resistance in circuit.

The variable grid leak illustrated is arranged to give maximum and minimum values in slightly less than one revolution and can be fitted with a scale calibrated to known values which will remain reasonably constant. The ebonite plate is about 2 ins. square by about $\frac{1}{4}$ in. in thickness and has a circular groove $\frac{1}{4}$ in. wide by 1/16 in.

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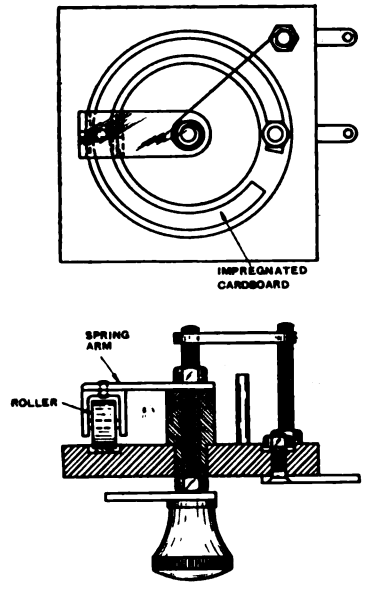
deep. A metal bush is fixed in the centre for carrying a rotating arm and spindle. A ring is made 1/32 in. thick of good quality cardboard 1½ ins. outside diameter by ⅛ in. wide and with a small segment cut away. This is soaked in drawing ink for several hours until it is thoroughly impregnated, after which it is removed, dried and fastened with gum to the bottom of the groove. Connection is made with the end in the manner shown. The contact roller is of brass and should have a highly polished surface. It is mounted by means of a small carrier on an arm constructed of springy brass. Connection between the arm and one of the tags is made by means of a spiral of phosphor bronze strip. Suitable sizes for



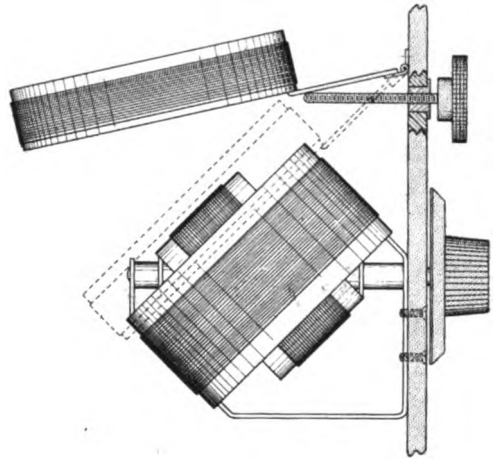
Variable grid leak construction with pointer passing over a scale to indicate value of resistance in circuit.

the roller are ⅜ in. diameter 3/16 in. wide, and with a 1/32 in. hole for pivotting. This instrument when completed was found to have a maximum resistance value of about 4 megohms and a calibrated scale was made giving values of ¼, 1, 2, 3, and 4 megohms.

A. E. S.

Reacting on to a Variometer.

WHEN a variometer is used for tuning aerial or anode circuits, reaction is usually needed to bring about an increase



Reaction coupling with a 180 degree variometer.

of signal strength and selectivity. The arrangement of the coils of a variometer renders the setting up of reaction coupling rather difficult and a suggested method is shown here, of suitably adjusting the position of the reaction coil as applied to the 180 deg. type of variometer. The reaction former is wound upon an ebonite or cardboard cylinder and attached to the panel by means of a short piece of brass soldered to a small hinge. It is propelled away from one of the variometer coils by means of a No. 0 B.A. screw passing through a threaded bush.

J. T.

A Simple Way of Matting Ebonite.

A quick and easy way of producing a good matt surface is to mix water with a little Vim, producing a thin paste. Place some of the paste on a small hard brush and well scrub the surface of the ebonite, being careful to scrub always in the same direction. When the matting is finished wash the surface of the panel in water and dry thoroughly. This method of matting leaves a soft and velvet-like finish.

J. C. L.

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THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

Anode Resistances.

IT is generally agreed by experimenters who have studied the resistance-capacity method of speech-frequency amplification that for good results it is essential to employ *wire*-wound resistances. The results obtained from a resistance-capacity coupled amplifier employing anode resistances of the grid leak type are usually unsatisfactory and disappointing. There is generally a background of noise—not a very violent crackling noise to be sure, but a buzzing noise which is sometimes of sufficient intensity completely to spoil the quality of the reproduction. That the noise is due to the anode resistances may be found by replacing them with wire-wound resistances of similar value.

As the anode resistances only have to carry a small current, of the order of 1-5 milliamperes, a very fine gauge of resistance wire may be employed. The table below gives the properties of several Eureka* wires from which the reader will be able to estimate the amount required for anode resistances of any value. The most suitable value depends, among other things, on the type of valve employed. Usual values are 40,000 to 80,000 ohms.

EUREKA RESISTANCE WIRE.

Gauge S.W.G.	Resistance ohms per 1000 yds.	Turns per inch of D.S.C. wire.
47	214,284	238
46	148,764	217
45	108,648	200
44	83,664	192
43	66,136	179
42	53,564	167
41	44,268	150
40	37,184	142

The anode resistances should preferably be wound non-inductively and to have a minimum value of self-capacity in order that the impedance of the units shall not appreciably vary with frequency. However, there is usually no need to go to great trouble to make them absolutely non-inductive or to wind them in a special manner to have a very low value of self-capacity.

A convenient former consists of a piece of ebonite rod having a number of grooves after the style of some types of tapped high-frequency transformers and anode reactances. Such a former is sketched in Fig. 1, and might, for instance, consist of a piece of ebonite rod two inches in diameter and 3 inches long with eight grooves 0·1 ins. wide and 0·2-0·3 ins. deep.

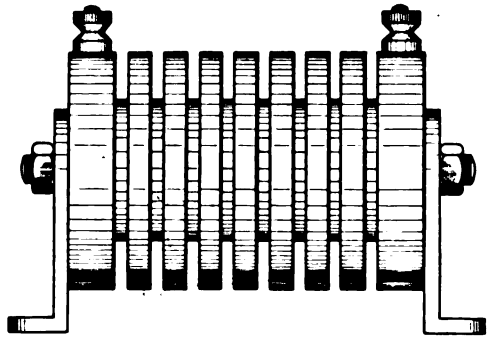

Fig. 1. A suitable former for a wire-wound anode resistance.

To make the winding practically non-inductive, wind, say, 25 turns in the first slot and then wind 25 turns in the second slot in the same direction. Now wind 25 turns each in the first and then the second slots in the opposite direction. Continue the work by putting as many turns as required in the first and second slots; then pass to the second pair of slots and so on until the resistance has the desired value.

For anode resistances No. 45-47 gauge wire, with a double silk covering is usually employed.

Those who do not want to make their own wire-wound resistances will find that Zenite rods, supplied by the Zenith Manufacturing Company, are very satisfactory.

*London Electric Wire Co.

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Resistances for Use in Transmitters.

The grid leaks employed in valve transmitters usually have a value of 6,000-15,000 ohms. Sometimes it is an advantage to have them variable in steps up to 30,000 ohms.

They may carry considerably larger currents than anode resistances: hence a heavier wire, such as No. 40 Eureka should be employed.

The grid leaks may be wound as described above, but it should be borne in mind that they may get hot or burn out if too many wires are wound in a single groove. It is better to provide a number of shallow grooves in the ebonite former.

A satisfactory grid leak may consist of strips of micanite wound with wire and slightly spaced. The strips may be supported below the surface of a panel of ebonite, and the tappings made to sockets or terminals mounted on the panel.

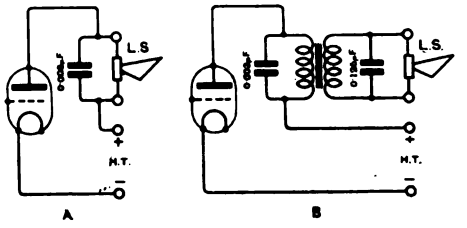

Fig. 2. The tone of music or speech may be improved in some instances by the use of fixed condensers.

Improving the Quality of Reproduction from Telephones.

It appears that no matter how good the wireless receiver itself may be it is possible to improve the quality of the reproduction from head telephones or loud speakers by the use of chokes and condensers. It is, of course, well-known that certain manufacturers recommend users of their products to connect a fixed condenser of rather large capacity across the telephones (or loud speaker). For instance one manufacturer recommends the values given in Fig. 2. Many experimenters, however, find that the results may considerably be improved by employing a condenser of one capacity for music, and a condenser of another capacity for speech.

The necessity for the use of correcting apparatus will more readily be appreciated when it is realised that the sound amplitude produced by signals of a given electrical strength for different frequencies varies, in the case of head telephones, something after the manner shown in Fig. 3. From this curve we see that even though the amplifier may give perfectly undistorted amplification, the

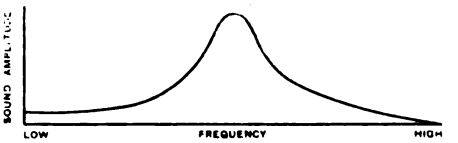

Fig. 3. Approximate characteristic curve for head-telephones.

amplitude of the notes will be very different to what they should be, because the head telephones respond very well to notes of intermediate frequency, and not so well to lower or higher notes.

The effect of the telephones in giving more sound for notes of middle frequency may be practically eliminated by connecting a rejector circuit in series, as indicated in Fig. 4.

The low frequency choke coil L and condenser C have values such that they offer a higher impedance to the currents of middle frequency. Thus this circuit, in series with the telephones, tends to make the characteristic of Fig. 3 a straight line.

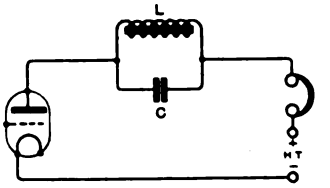

Fig. 4. A parallel circuit consisting of capacity and inductance employed to improve the quality.

Those who wish to make experiments will find that the primary winding of some types of low frequency transformer serve very well for the coil L. The value of the condenser C should be varied up to about 0·006 microfarads.

This method is not so suitable for improving the quality from loud speakers, because loud speakers in general have a curve which is very different to that of Fig. 3.

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WAVEMETERS.*

By L. B. TURNER, M.A., M.I.E.E.

Section 1.—Introduction. *Section* 2.—Absolute Measurements. (*a*) Natural frequency of L, C, R circuit. (*b*) Oscillograph. (*c*) H.F. Alternator. (*d*) Lecher Wires. (*e*) Multivibrateur. *Section* 3.—Comparison of frequencies, and forms of calibrated instruments. *Section* 4.—Heterodyne wavemeters. *Section* 5.—Wavelength standards. *Section* 6.—Points in the design of an every-day wavemeter.

(1) INTRODUCTION.

SOME seventy years ago Lord Kelvin proved theoretically that the discharge of a Leyden jar might be oscillatory—a fact with which every one of us now is very familiar, but which had been first suspected by the experimentalist, Joseph Henry, in 1842. Forty odd years have elapsed since Hertz, taking advantage of this fact, first said "Let there be electric waves," and, behold, wireless telegraphy was created. During this brief period, and especially during the last quarter of it, the wireless science and art together have so progressed that to-day you and I, and a tenth of the population of the country, personally utilise and control these electric waves; we quote their length, and we measure the frequency of the associated currents—the rate of those alternations discovered by Joseph Henry, whose name we use whenever we specify the inductance through which these currents flow.

The intention of my paper is to sketch out the methods which may be used in measuring the frequencies met with in wireless; to describe very briefly some of the circuits and apparatus; and to consider the design of a wavemeter, which, in some form or other, is part of the necessary equipment of every experimentalist.

In case the relationship between wavelength and frequency, as these terms are used in the wireless jargon, is not perfectly clear to all, let me preface the following explanation.

Clerk Maxwell showed that every disturbance in free space (æther) propagates itself with the same velocity, say c; and since light is an æther disturbance, c is often referred to as the velocity of light. It is found to be very nearly 3×10^{10} cm./sec. If the disturbance is periodic in time—if, for example, it is set up by an alternating current of frequency n p.p.s. in a wireless aerial—the disturbance takes the form of a wave, like the wave motion on the surface of a pond into which a stone has been cast; and if λ stands for the length of the wave (*i.e.*, the distance between crest and crest at any instant), we have the necessary relation

$$c = n\lambda$$

In cms. and secs.

$$n = \frac{3 \times 10^{10}}{\lambda}$$

$$\text{or } n \text{ (p.p.s.)} = \frac{3 \times 10^{8}}{\lambda\,(m)}.$$

Actually we more often observe n, the frequency of the alternating current in a circuit, than λ, the wavelength of the radiation; but since there is this fixed relation, it does not matter which we measure or specify; and the instrument which is really a frequency meter may be—and generally is—called a wavemeter, and be calibrated as such.

(2) ABSOLUTE MEASUREMENTS.

(*a*) *Natural Frequency of L, C, R Circuit.*

If the L, C, R circuit in Fig. 1 is disturbed, then left alone, it will oscillate (as we say) with a damped alternating current of frequency

$$n_0 = \frac{1}{\left(2\pi\sqrt{LC - \frac{R^2}{4L^2}}\right)}$$

$$= \frac{1}{(2\pi\sqrt{LC})} \text{ very nearly in lowly}$$

damped circuits.

*A paper read before the Radio Society of Great Britain on Wednesday, November 26th, at the Institution of Electrical Engineers.

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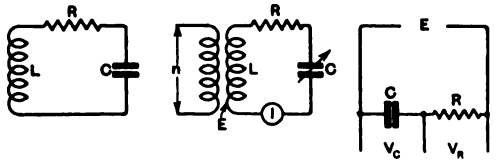
If, therefore, we can measure C, L (and R), we can calculate the frequency of the current produced. Alternatively, if we have available an alternating current of frequency n, we can excite the circuit therefrom by inducing in it an e.m.f. E of frequency n, as in Fig. 2. The current I then produced has the magnitude

$$I = \frac{E}{\sqrt{R^2 + \left(2\pi nL - \frac{1}{2\pi nC}\right)^2}};$$

and if we vary C or L until I becomes a maximum $\left(\text{viz., } \frac{E}{R}\right)$, we have

$$2\pi nL = \frac{1}{2\pi nC}$$

$$i.e., \; n = \frac{1}{(2\pi\sqrt{LC})}.$$



Figs. 1, 2 *and* 3.

Again, we can deduce n if we know L and C.

The difficulty is that we cannot measure L and C very accurately for such high frequency currents; especially are the stray capacities of the coil L and the leads very difficult to ascertain with accuracy. The latter difficulty could be eliminated by omitting L, as in Fig. 3, and adjusting C or R until the two P.D.'s V_C, V_R were equal. Then

$$\frac{1}{2\pi nC} = R$$

$$i.e., \qquad n = 2\pi CR$$

But we should then be faced by the stray capacity across R, and the necessity of having an e.m.f. E of pure n frequency.

For such reasons it is not practicable to determine the high frequencies met with in wireless with great accuracy from measurements of C, L and R.

(*b*) *Oscillograph.*

I remember that when I first became connected with wireless telegraphy we had in the Post Office a grant of (I think) £200 to be expended on attempts at the N.P.L. to photograph the sparks across a gap in an L, C circuit. By actually counting the sparks shown in the photograph as occurring in a known fraction of a second the frequency of the current would be determined. This method has the virtue of extreme directness, requiring measurement only of time and number; but it is very cumbersome and difficult, and the presence of the spark gap is objectionable. More recent oscillographic developments of this same method are a great advance in practical detail. They are, I imagine, capable of giving accurate determinations, but are necessarily difficult and costly.

(*c*) *H.F. Alternator.*

When an alternating current is produced by an ordinary electro-mechanical machine, the frequency is easily found by the use of a watch and a revolution counter. A high-frequency alternator would thus constitute an ideal means for absolute determination of frequency and wavelength. Unfortunately for the high frequencies of wireless—at any rate those corresponding with the shorter wavelengths—such machines are impracticable, even as instruments for laboratory measurements.

(*d*) *Lecher Wires.*

Let a pair of long straight parallel thin wires be supported so as to be far from the ground and other conductors in comparison with their separation from each other. It can be shown that an electrical disturbance propagates itself along the pair with a speed given by an expression which, in practical cases, is sensibly equal to the velocity of propagation in free space, *i.e.*, the "velocity of light." Hence frequency and wavelength of oscillations excited on these "Lecher wires" (as they are called) bear the relation already referred to. If, therefore, we excite such a pair with standing waves by coupling to a triode oscillator, as in Fig. 4, maxima of current will be developed at the spots I_1, I_2, I_3 . . ., and maxima of P.D. at V_1, V_2, V_3 . . . . On observing the positions of successive maxima or minima, by means of a Neon tube or otherwise, the wavelength is found as

$$\lambda = 2\,(V_1\,V_2) = 2\,(V_2\,V_3).$$

This, unlike all the other methods considered, is a direct determination of wavelength; we deduce n from an observed λ,

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instead of λ from a more or less directly observed n. The method was originally used with spark oscillators, the shock excitation of which introduces awkward complications, and it is obviously impracticable for long waves; but with C.W. oscillators it appears to be quite a feasible method, and has recently been used for wavemeter calibration by Townsend and Morrell.* Their oscillator, whose wavelength was

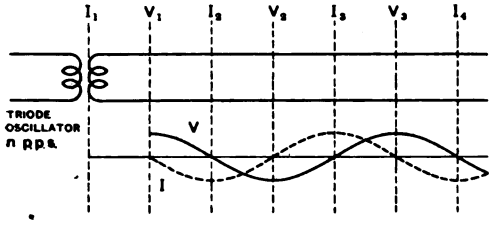

Fig. 4.

measured on the Lecher wires, had a frequency of some 60×10^6 p.p.s. ($\lambda = 5m$), and was used to check a longer wave oscillator by the method of harmonics, of which more hereafter.

(e) Multivibrateur.

It is well known that any periodic quantity of frequency $n = \frac{p}{2\pi}$ —*i.e.*, repeating itself every $\frac{1}{n}$ secs.—can be analysed into the sum of a series of harmonic terms of frequencies n, $2n$, $3n$ . . . More precisely, if i is any periodically varying current, i may be represented by the Fourier series,

$$i = I_1 \sin(pt + \theta_1) + I_2 \sin(2pt + \theta_2) + I_3 \sin(3pt + \theta_3) + \ldots$$

provided that the amplitudes I_1, I_2 . . . and the phase angles θ_1, θ_2 . . . are suitably chosen.

We are not here concerned with the phase angles, but only with the amplitudes of the several harmonic terms. If i is itself a nearly pure sine current, as in most ordinary A.C. circuits, the harmonics I_2, I_3, I_4 . . . are small compared with the fundamental I_1; but if i is of a suitably jerky character, the harmonics even far along in the series may be quite appreciable.

This fact was very elegantly utilised by Abraham and Bloch† in 1917. They devised a method of interconnecting two triodes with resistances and condensers, by which extremely sudden reversals of current could be effected at regular intervals, such, for example, as 1/1000 sec. This current is representable by the Fourier series already quoted, where now $p = 2\pi \times 1000$; and owing to the very pronounced jerkiness of the current, the amplitudes I_2, I_3 . . . to beyond I_{100} are quite well marked.

Suppose we pass this current through a coil coupled lightly to a wavemeter circuit as in Fig. 2. Instead of the single frequency n in the coil on the left, we now have currents of frequencies n and $2n$ and $3n$ and . . . $100n$ and . . .; and there will consequently be a maximum of current I whenever the wavemeter resonates to one of these frequencies. Supposing, for example, we turn the condenser handle over the part of the scale corresponding to wavelengths about 3,000 metres, there will be a current maximum at:

$\frac{n}{(p.p.s.)}$	. . .	99,000	100,000	101,000	. . .
λ (m)	. . .	3,030	3,000	2,970	. . .

If the wavemeter circuit is sufficiently lowly damped—if its decrement

$$\delta = \pi \sqrt{\frac{C}{L}} R$$

is not greater than (say) about 0·02—these peaks will be distinguishable; and we can thus determine the frequency to which the wavemeter is resonant with precisely the same percentage accuracy as the fundamental frequency is known. It is quite easy to measure acoustic frequencies of the order of 1,000 p.p.s. by noting the beats with a tuning fork or other source of sound of nearly the same pitch; so that the wireless frequency of, say, $h \times n$ is found as h times the fork frequency n, where h is known to be exactly 100 or 99 or 101 or whatever harmonic is chosen.

The triode arrangement used by Abraham and Bloch was designated by them a "Multivibrateur." But a clever man—or even a dull man now that clever men have shown us the way—can do almost anything with a triode or two, some time, and a little

*Phil. Mag. XLII., p. 265 (1921).

†Ann. de Physique, 9e série, XII, p. 237 (1921).

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money; and a variety of substitutes for the Multivibrateur can be employed. In particular, almost any ordinary triode oscillator thrown together in the laboratory will give currents fairly rich in harmonics; and if we are satisfied to pass from the acoustic frequency of 1,000 p.p.s. to the wireless frequency of 100,000 p.p.s. in two stages instead of one, we can fairly easily use an acoustic oscillator of 1,000 p.p.s. adjusted from a tuning fork, take its tenth harmonic to calibrate another oscillator of 10,000 p.p.s., and use its tenth harmonic to give us the frequency of 100,000 p.p.s. corresponding with the wavelength of 3,000 metres.

In the Multivibrateur method, and its variations, we have a very beautiful and quite practical means of making absolute measurements of high frequencies with all the precision of the time measurement involved in counting the periods per second of the fundamental frequency. But such absolute determinations most of us prefer to delegate to experts at the National Physical Laboratory or elsewhere, for establishing the standard signals transmitted for our service, or for calibrating instruments which we ourselves handle as substandards. These are our ordinary wavemeters; their scale indications we accept, and we use them for setting other instruments to equal wavelength. Accordingly, I pass now to—

(3) COMPARISON OF FREQUENCIES AND FORMS OF CALIBRATED INSTRUMENTS.

In theory, perhaps, the simplest arrangement which might be calibrated as a wavemeter is something of the sort shown in Fig. 5. With a variable condenser C or a variable resistance R, we can calibrate C against R to give equal currents I_C, I_R. There are three practical objections to such an arrangement:

(i) Two current readings are needed.
(ii) We can set C or R only to the same accuracy as we can read I.
(iii) Large power is required because of the heat loss in R.

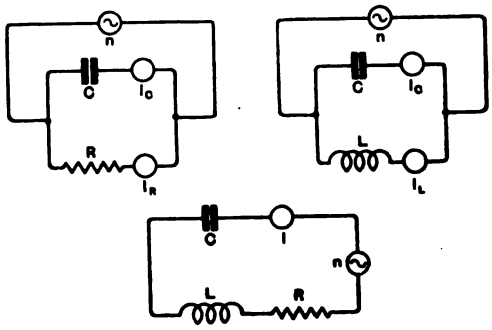
Objection (iii) is avoided on substituting an inductance L (with, let us suppose, negligible resistance) for the resistance R (Fig. 6). Objections (i) and (ii), however, remain.

We avoid (i) and (ii) also if we impress the e.m.f., whose frequency we are observing, *in series with* C and L (Fig. 7) instead of across them both. If E is that e.m.f. of frequency n, we now have, as we saw in Section 2, a maximum current I when C and/or L are adjusted to make

$$\frac{1}{2\pi nC} = 2\pi nL$$

$$i.e.,\ n = \frac{1}{(2\pi\sqrt{CL})}$$

We have to make only a single observation of current, and we do not need to note its value, but merely to bring it to a maximum.



Figs. 5, 6 *and* 7.

That we do not know the true values of C and L, as explained in Section 2, does not matter when once the wavemeter has been calibrated in terms of frequency or wavelength.

Assuming that the scale of our wavemeter is correctly calibrated, how closely can we measure with it? This depends on:

(*a*) How small is the change of I we can detect.

(*b*) How low is the damping of the circuit?

If we plot a curve showing the values of I as n is varied, we get the familiar "resonance curve" of Fig. 8. The shape, the "peakiness," of this curve depends only on the "decrement" δ of the circuit, where $\delta = \pi\sqrt{\frac{C}{L}}R$. Fig. 8 is drawn to scale for the cases of $\delta = 0{\cdot}01$ and $\delta = 0{\cdot}1$. It is easy to calculate that the current falls (say) 1 per cent. below its peak value on distuning the frequency by $\frac{\delta}{\sqrt{2}\,\pi}$ of the resonance frequency. Taking the sharper curve, therefore, and assuming we could detect 1 per cent. drop of current, we could set our

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wavemeter with an uncertainty not exceeding $\frac{0{\cdot}01}{\sqrt{2}\,\pi} \doteqdot 0{\cdot}2$ per cent. ; and with the blunter curve similarly 2 per cent.

Thus, the lower the decrement of the wavemeter circuit, the better the wavemeter ; but for most purposes a very fair accuracy can be got even though the decrement is rather high. I may mention that an oscillatory circuit can be built with a decrement of 0·02 or 0·03 without great difficulty.

An ordinary wavemeter always takes the form of an oscillatory circuit, of the lowest decrement that considerations of size and cost will permit, provided with a scaled variation of either C or L or both. The outstanding features of design are the means by which it is coupled to the circuit

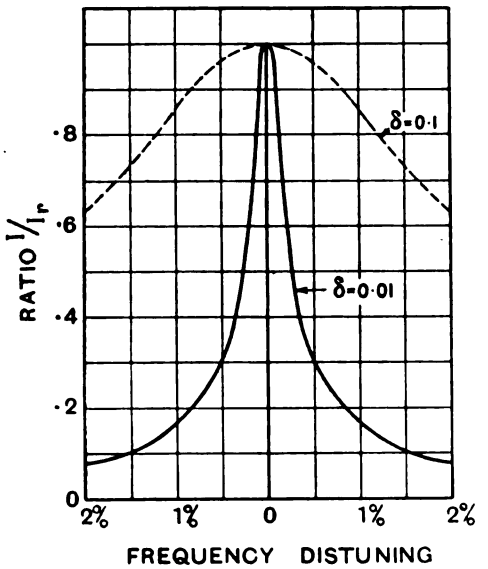

Fig. 8.

or source of e.m.f. under observation ; the means for detecting the amplitude of oscillation evoked when it is responding to an impressed e.m.f. (*i.e.*, acting as a receiver) ; and the means by which it is itself excited when it is required to act as a transmitter. I will touch on these points in Sections 4 and 6.

(4) HETERODYNE WAVEMETERS.

There is no need nowadays to emphasise the advantages of C.W. as opposed to damped train technique. An obvious way to excite our wavemeter circuit is to connect it to a triode so that the whole generates steady oscillation at the frequency mainly determined by, and controllable by, the product $L\,C$. Such a wavemeter is usually called a heterodyne wavemeter, because it can be used to give the heterodyne effect with incoming C.W. signals or with another heterodyne wavemeter. By the heterodyne method two frequencies (n_1 and n_2) can quite easily be adjusted to equality within 100 or less periods per second. Suppose these frequencies correspond with wavelengths of about 300 metres ($n = 10^6\ p.p.s.$). Then the ratio $\frac{n_1}{n_2}$ or $\frac{\lambda_2}{\lambda_1}$ is known to within 100 in a million, *i.e.*, to within 0·01 per cent. Observe that this very close comparison does not depend upon the provision of lowly damped circuits.

Another feature of the heterodyne wavemeter of great practical value is that it can be used as transmitter or as receiver without any changes in its circuits whatsoever. A pair of telephones is put in the H.T. battery circuit and left there whether the wavemeter is acting as transmitter or receiver.

Further, there are the harmonics of the triode oscillator. Sometimes these are a nuisance, and must be reduced in intensity as much as possible ; more usually they are of great utility, as extending the range of the instrument in the manner described in Section 1 (*e*). To generate a current rich in harmonics, the triode retroaction should be much greater than the critical amount causing oscillation to set in. If the even harmonics are wanted—and it is difficult to keep them out—the oscillation should be made strongly asymmetric by putting the mean grid potential well above or well below the value which makes the non-oscillating anode current equal to half the saturation current.

When two heterodyne wavemeters, both rich in harmonics, are used together, it is sometimes very difficult to ascertain which pair of frequencies are combining to give any particular heterodyne scream. Unless the scales of both instruments have been calibrated so as to be tolerably closely accordant already, it is desirable to reduce as much as possible the harmonics in one of the oscillators (*A*, Fig. 9), and to place the telephone in the other oscillator (*B*).

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Heterodyne screams associated with harmonics of A are then more easily distinguishable (if heard at all) from screams got with the fundamental of A by the relative weakness of the former.

But even when one of the oscillators, A, is sensibly free from harmonics, doubts often arise as to which of the harmonics of B is causing a certain scream. A decision is come to most simply as follows. Suppose B is our standard wavemeter, and we wish to calibrate A from B's harmonics, A's indications at present being only *roughly* interpretable in terms of wavelength λ, capacity C or inductance L.

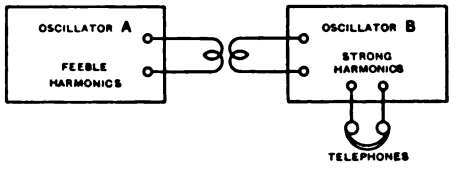

Fig. 9.

Set B to a known wavelength λ_B. Then we know that B is emitting currents of λ_B, $\frac{1}{2}\lambda_B$, $\frac{1}{3}\lambda_B$, $\frac{1}{4}\lambda_B$, etc. Turn A until a scream is heard, and let its middle be at λ, C *or* L, as roughly given by A's scale. We then know that the accurate value of λ is $\frac{\lambda_B}{h}$ where h is either 1, 2, 3 , , , but which of these integers we know not. Now decrease A until the next scream occurs, at λ^1, C^1 or L^1 (say). Then the value of h is given from the approximately observed ratio $\frac{\lambda}{\lambda^1}\left(\frac{C}{C^1}\text{ or }\frac{L}{L^1}\right)$ by Table 1, which is self-explanatory.

TABLE 1.

Standard Wavemeter	λ_B	$\frac{1}{2}\lambda_B$	$\frac{1}{3}\lambda_B$	$\frac{1}{4}\lambda_B$	$\frac{1}{5}\lambda_B$	$\frac{1}{6}\lambda_B$	$\frac{1}{7}\lambda_B$	—
h	1	2	3	4	5	6	7	—
λ/λ^1	2	1·50	1·33	1·25	1·20	1·17	—	—
C/C^1 or L/L^1	4	2·25	1·78	1·56	1·44	1·36	—	—

A single example will make this clear—an example taken from an actual calibration of Range 1 (100-200 metres) of the wavemeter described in Section 6. λ_B was 400 metres. Successive screams occurred at 44 degs. and 18 degs. on the scale. Rough calibration of the wavemeter on another range had shown

44 degs. meant 468 metres,
18 degs. meant 357 metres, approximately.

Hence $\frac{\lambda}{\lambda^1} = \frac{468}{357} = 1{\cdot}31$ approximately.

Reference to the table shows that the harmonics were the third and fourth; and we have found that

44 degs. means $\frac{400}{3} = 133{\cdot}3$ m.

18 degs. means $\frac{400}{4} = 100{\cdot}0$ m.

precisely. Later on, the position 18 degs. was found again with the fifth harmonic of $\lambda_B = 500$ m.

The harmonics procedure enables one to calibrate over any range of wavelengths by the use of a few known wavelengths. Thus suppose we have only a wavemeter whose calibration from 300 metres to 600 metres is reliable. An oscillator may be adjusted by use of this wavemeter to yield the frequencies, say, shown in the first row of Table 2.

TABLE 2.

Millions of periods per second.

·5	·6	·7	·8	·9	1
1	1·2	1·4	1·6	1·8	2
1·5	1·8	2·1	2·4	2·7	3
2	2·4	2·8	3·2	3·6	4
2·5	3	3·5	4	4·5	5

while the frequencies of the second, third, fourth and fifth rows are given by the second, third, fourth and fifth harmonics. Ignoring the small-figure terms (which are, however, useful as checks), a series of well-distributed points of known wavelength are obtained covering the whole range 600 metres—60 metres.

(*To be continued*).

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PATENTS AND ABSTRACTS

An Automatic Filament Safety Switch.

In valve receivers which have a filament on-and-off switch, it is possible that although the filament controlling resistances have been left in the positions which have been found to give good results, when the filament switch is closed to bring the receiver into use again, the filaments of the valves may

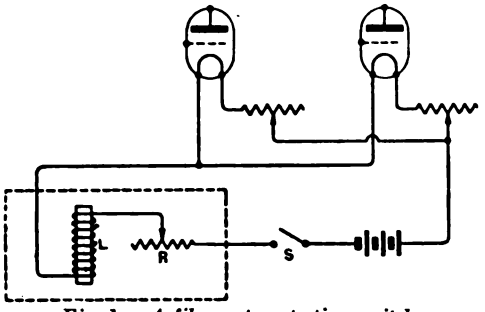

Fig. 1. A filament protecting switch.

be fractured owing to the voltage of the battery having increased. This is particularly likely to occur with dull-emitter valves heated by dry cells, but may also occur with ordinary valves which are heated from an accumulator. Apart from the fact that the voltage of the battery may have increased during the time that the receiver is not in use, it is well known that a filament is liable to break if the current is suddenly applied.

It has been proposed (Patent No. 221,027) to employ an arrangement connected as in Fig. 1, where L is an electro-magnet and R a resistance. So long as the switch S is closed, the arm of the resistance, R, is held in position by the current flowing through the electro-magnet. When the switch is put in the "off" position, the arm of the resistance is released, and moves to the point where the maximum value of resistance is in circuit. Hence, when the circuit is closed by operating the switch, the full value of the resistance R is in circuit, and the current flowing through the valves is limited. The value of the current may then be increased by adjusting the main resistance R.

Adjustable Resistances.

Adjustable resistances of the carbon pile type employed as grid leaks or filament rheostats usually consist of discs or pellets of carbon or of fibrous material impregnated with carbon. It has been proposed to make the discs of resilient material, also to press them together by means of a spring. In this type of adjustable resistance, however, the discs or pellets sometimes stick together, so that when the compression pressure is relieved somewhat there is not obtained the resistance variation which should accompany such relief of pressure.

It has been proposed to remove this disadvantage (Patent No. 224,061) by employing springs between the discs of the pile as sketched in Fig. 2. A tube A has its ends closed by plugs B and C and a compression screw E, and the discs H of the pile are

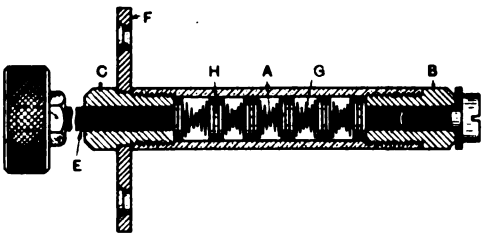

Fig. 2. An adjustable "carbon pile" type resistance.

separated by springs G. The flange F is for attaching the unit to a panel. Every disc may be separated from its neighbour by a spring as indicated in the sketch, or fewer springs may be employed.

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THE SUPER-HETERODYNE RECEIVER

A DESCRIPTION OF THE RADIOLA (SECOND HARMONIC) RECEIVER

By JOHN R. WORTLEY-TALBOT.

THROUGH the courtesy of the Editor of *The Wireless World and Radio Review*, I am enabled to give readers a short account of this wonderful receiver, which I have had in use for some time.

The complete cabinet contains the super-heterodyne equipment of condensers, transformers, oscillator coils, also the low tension, high tension and grid bias batteries, which are all of the dry type, six U.V.199 Radiotrons, and its own loop aerial. The valves are of the dull emitter type, each taking 0·06 of an ampere at a pressure of 3 volts. A plate voltage of 90 is employed.

The receiver will tune from 220 to 550 metres with the loop provided, but a larger external loop may be used, provision being made in the receiver to do this if required. An earth lead may be used, or a short length of wire under the carpet or round the picture moulding, which is not connected to earth.

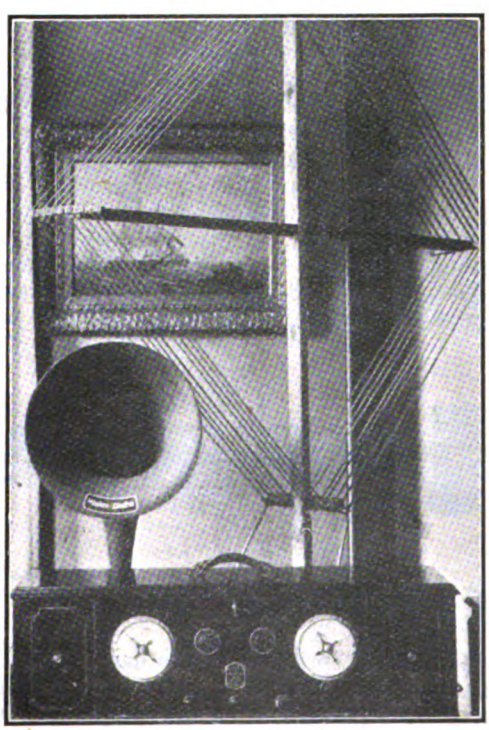

***Fig.* 1.** *A front view of the receiver showing the controls, the loud speaker and the frame aerial.*

The cabinet itself is beautifully made and finished in mahogany, and on the front are the following controls. The left-hand dial is called the station selector No. 1, and is the variable condenser tuning the loop. The dial on the right-hand side (looking from the front) is the condenser controlling the frequency of the oscillator. Of the two knobs in the centre the one on the left is the master rheostat, the one on the right being a potentiometer. controlling the voulme The condensers are vernier, operated by universal joints to metal plates at the back of the condenser, giving a very easy and fine control.

The three small knobs at the bottom are as follows: the right-hand one is for a plug, for loud speaker or 'phones, as required; the centre knob switches on *all* the valves and the H.T. When the left-hand knob is pulled out it cuts out valves 4 and 5, and permits one to receive on four valves only, the telephony on four valves and a 3 ft. loop being beautifully clear and strong, especially from Madrid.

The tuning is remarkably simple. One just needs to plug in a pair of 'phones, pull out the centre bottom switch, put the rheostat to about No. 40 on its dial (with new batteries), turn the condenser, and increase the volume control until the signal is as strong as one desires. If too loud, pull out the left-hand bottom switch, and you are receiving then on four valves.

As a matter of fact, although this receiver will operate the loud speaker direct on its own aerial and six valves, still I much prefer to couple four valves of the super heterodyne to either of two power amplifiers—a Western Electric power amplifier equipment, which will give exceptional volume, or a resistance

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coupled power amplifier, using Dubilier resistances and three Western Electric 216 A type power valves. The complete amplifier has its own low and high tension batteries. This gives most wonderfully natural reproduction, due to the fact that no iron core transformers are used in either circuit. It would be quite deafening to use the full six valves of the super heterodyne and the power amplifier together; although, curiously enough, there would be no howling, but altogether too much volume.

I have received great numbers of stations on the loud speaker, both with and without the amplifier, which I could not recognise; German, French, two Spanish (of which I know Radio Iberica), and all the British stations including Belfast.

I tried the earth lead for reception, but, although tremendously sensitive, it brought in so many ships that I returned to the 3 ft. loop. This loop consists of nine turns (1 in. apart, 3 ft. square) $\frac{1}{4}$ in. by 1/64 in. silicon bronze strip, and is remarkably effective.

I may say that it will be found in using a power amplifier with this set that the volume control knob can be turned back very much towards "soft," with a corresponding increase in purity and absence of noise. Static appears to be the one bar to receiving any station within a thousand miles that may be transmitting on fair power between 220 and 550 metres. No skill is required to work this set. One cannot go wrong. Only one item—if *you have not enough* filament emission you will get distorted telephony; if you have too much there will be a continuous hiss in the loud speaker. There is no whistle in tuning. The telephony just comes in weak or loud, according to the volume control setting, and anyone can get these results without any previous knowledge of a super heterodyne. The set is as selective as one could desire, although I have no opportunity of giving the set a crucial test, as the nearest $1\frac{1}{2}$ kW. station is about 100 miles away from here. The valves, batteries, etc., have never given a moment's trouble, and the set works on an average two hours daily. It is well worth its cost, as it gives exceptional results.

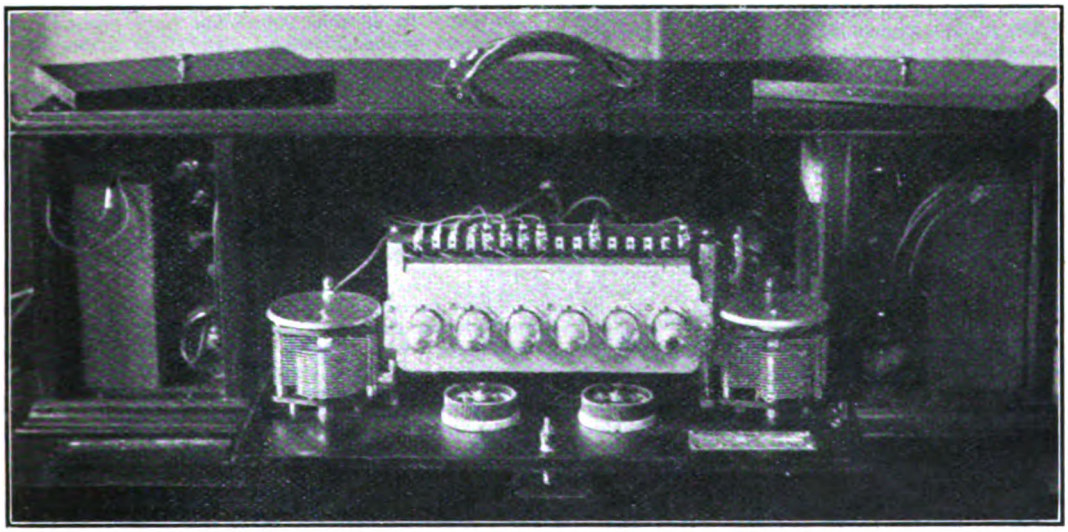

Fig. 2 A view of the super-heterodyne receiver, showing the tuning condensers, filament resistance and potentiometer.

The range of this set can be very much increased by tuning an ordinary 50-turn Igranic coil by a variable condenser connected in series with the usual type of outdoor aerial. When the coil is tuned and the outdoor aerial and the super heterodyne loop are in resonance, and are tuned to the same wavelength, there is a marked increase in signal strength.

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NOTES & NEWS

According to a Reuter message, an amateur wireless station at Dartmouth, Nova Scotia, has established two-way communication with New Zealand.

* * * *

The Moscow broadcasting station, operating on 3,200 metres, transmits a complete programme in Esperanto on the last day of each month.

* * * *

Wireless telephonic communication has been established between the Crosby lightship and the Mersey Dock Board offices. The Bar and Formby lightships are in similar communication with the mainland.

* * * *

M. Menars, the well-known French amateur, reports the reception of a Tokio amateur on a wavelength of 90 metres. Confirmation of this feat will be awaited with interest.

* * * *

The Irish Free State Posts and Telegraphs Department announces an examination for the granting of certificates of proficiency to wireless operators. Particulars may be obtained from the Secretary of the Department, Dublin Castle.

* * * *

ARGENTINE DA 8 BUSY.

Good reception of Argentine **DA 8** (ex **CB 8**) is reported by Mr. C. W. Goyder **(2 SZ)**, the well-known Mill Hill transmitter. On Sunday, November 30th, from 6.45 until 7.40 a.m. (G.M.T.) the Argentine station was heard working frequently with **U 7GW** and **U 6GG**, both of which are situated on the Pacific Coast of America. **DA 8's** signals were of fair strength, with a steady D.C. note, and his wavelength was 95 metres.

It will be remembered that Mr. Carlos Braggio **(DA 8)** is transmitting daily from 4.30 to 5.30 G.M.T., on a wavelength of 120 metres. Amateurs who succeed in hearing these signals are requested to report direct to Mr. Braggio, at Alsina 412, Buenos Aires, Argentine.

Mr. Goyder also reports faint reception of Mexican **BX** on the morning of December 1st. These signals were on a wavelength of 92 metres, with rectified A.C. note.

NEW SWISS BROADCASTING STATION.

A new broadcasting station, states our Continental correspondent, has been established at Dubendorf, near Zurich, operating on a wavelength of 1,980 metres ; it employs the call sign **HBK.**

U.S.—CHILI TWO-WAY WORKING.

A "genuine Chilian hat" is to be presented by a prominent and delighted Chilian experimenter to Mr. Glen A. Litten, of Orange, California, for being the first American amateur to work a Chilean station. In all four Americans have carried out two-way communication with Chili during the Pan-American tests, and these men are credited with having made the best South American records since DX work was established with the Argentine. In addition to Mr. Litten, they are Mr. Maurice E. McCreery, of Los Angeles, Mr. William L. Williams, of Pomona, California, and Mr. Robert W. Kennedy, of Riverside, California.

BELGIAN AMATEUR TRANSATLANTIC TESTS.

Low power communication tests with America are being carried out by a number of Belgian amateurs, who propose to use powers of from 6 to 15 watts. These transmissions will take place on the following dates : December 21st, 22nd, 25th, 26th, 28th, 29th ; January 1st, 2nd, 4th, 5th, 11th, 12th, 18th, 25th, 26th ; February 1st and 2nd.

The wavelengths will be from about 100 to 120 metres, plate supply being 50 cycles unrectified A.C. The times of these transmissions on each of the above dates are as follows : 0400 to 0415, 0430 to 0445, 0500 to 0515, 0530 to 0545 G.M.T.

NEW CLOCK AT GREENWICH.

We regret that owing to a misunderstanding the new free-pendulum clock reported in our last issue as having been installed at Greenwich was referred to as being the invention of Mr. F. Hope-Jones ; whereas the instrument is only being manufactured by the Synchronome Co., of which Mr. Hope Jones is the managing director. The clock is the third of the series of "Clocks Shortt," which have been specially designed by Mr. W. H. Shortt, M.Inst.C.E., and embody inventions covered by his own patents, as assigned to the Synchronome Co., Ltd.

HUNGARIAN AMATEURS OFFICIALLY HONOURED.

An association of Hungarian wireless amateurs has just been formed under the Presidency of Herr Josef Hollos, Professor in the State Technical High School. A seat on the Committee is stated to have been taken by Herr Franz Kohl, who is Under-Secretary of the Government Postal Service.

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SWEDISH SMZN ASKS FOR REPORTS.

Owned by Mr. George Holmlund, of Rosenlundsgat, 3 Gothenburg, Sweden, **SMZN** transmits generally on Wednesdays, Saturdays and Sundays from 10 p.m. onwards (G.M.T.) on wavelengths between 100 and 120 metres. Reports are always welcome.

A VALUABLE VALVE BOOK.

One of the most useful of reference books to the amateur experimenter has just been issued by Messrs. Marconi's Wireless Telegraph, Co. Ltd., under the title, "Marconi Valves made at the Osram Works." This publication covers an extensive range of the Osram valves now in use, classified under Transmitting, Rectifying and Receiving Valves.

A photograph of each valve is included, together with its characteristic curve and full working data. The book (Pamphlet No. 233) can be obtained from the Company, Marconi House, Strand London, W.C.2. Price, 5s. net.

WEST OF ENGLAND TRANSMITTERS' SECTION.

Further details of the new Society of transmitting amateurs in the West of England, founded on November 27th at Bristol, may be of interest.

The inaugural meeting was held at the Merchant Venturers College, Bristol University, and after discussion it was unanimously agreed that the interests of transmitters would be best served by their banding themselves together for mutual protection and research work. The Chairman of the new organisation is Mr. W. A. Andrews, **5 FS**, and the Hon. Secretary, Mr. U. A. Porter, **2 AKG**.

Permission is to be asked to install transmitting gear for the use of the Society, and arrangements have been made whereby one subject of research will be undertaken by members each month. Another useful feature will be the instruction of closed licence holders in the handling of transmitting gear, with a view to their being granted a full open licence. Between 25 and 30 transmitters have already joined the Section.

SORBONNE LECTURES FROM PTT.

So great was the public appreciation last winter of the broadcasting of educational courses from the Sorbonne, Paris, that the scheme is being extended this winter. Four complete courses will be given covering subjects of historical and literary appeal. As hitherto, the transmissions will be conducted from **PTT**, on 450 metres, and will take place on Monday, Wednesday and Thursday afternoons.

SENATORE MARCONI ON BEAM TRANSMISSION.

Senatore Marconi, in the course of his inaugural address as Chairman of the Council of the Royal Society of Acts, on Thursday, December 11th, emphasised the changes which long distance wireless communication was now undergoing as a result of the recent discoveries in short wave transmission.

The primary value of the very short wavelengths lay in their suitability for directional work and the lower powers which could consequently be employed. For broadcasting purposes the longer wavelengths were more desirable.

Summarising his work in the matter of short waves, Senatore Marconi expressed the opinion that they opened up what he believed would prove a most fertile field for the investigator and an entirely new horizon to our view.

BROADCAST RECEPTION IN INDIA.

The first experiment in open air broadcasting in Bombay was recently carried out with success, a musical programme being reproduced on loud speakers to a large audience specially invited by the Municipal Commissioner.

A correspondent informs us that listeners in Bombay have recently been very successful in picking up British broadcast programmes.

The successful reception of **2 LO** in Calcutta was reported last year.

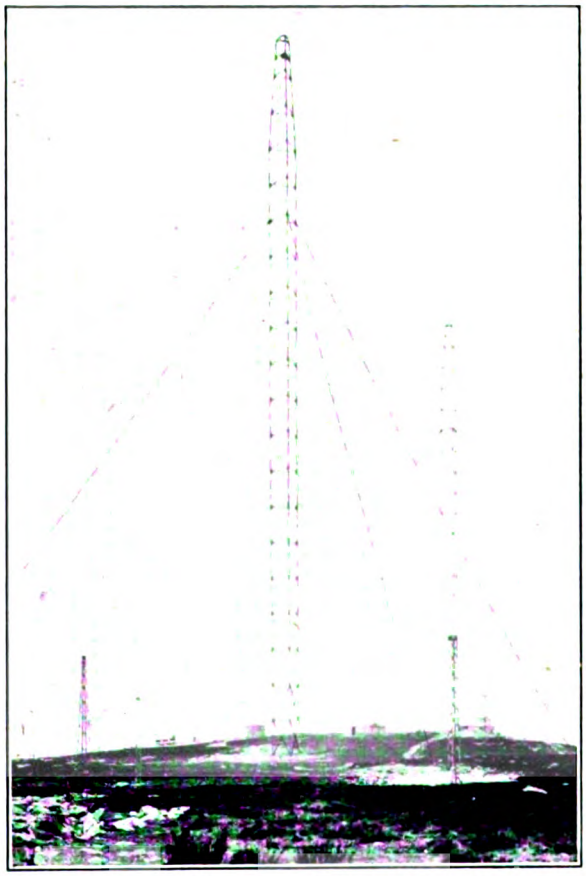

Photo: Marconi's Wireless Telegraph Co., Ltd.

Two of the new **400-ft.** *single-stayed lattice masts at the Carnarvon Marconi station.*

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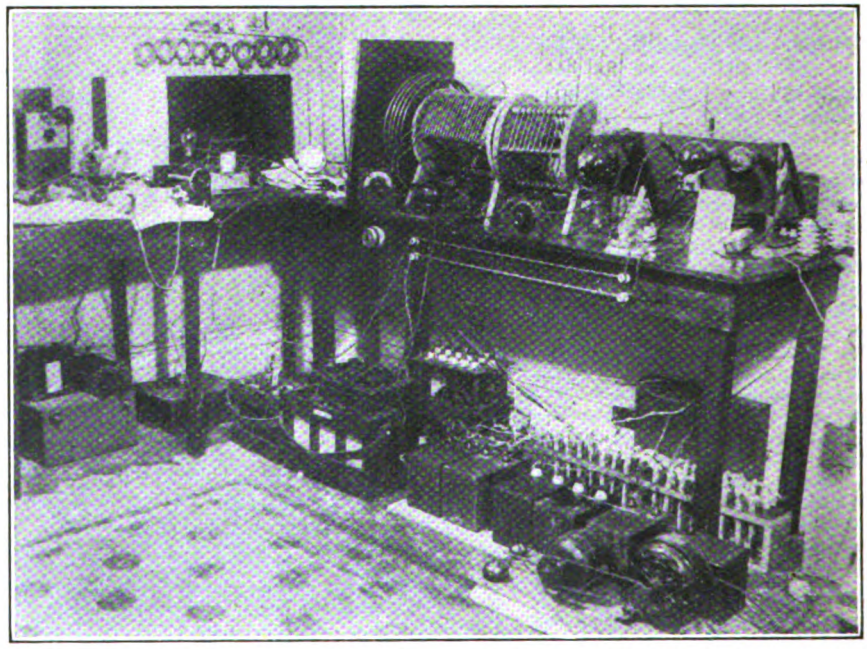
Calls Heard

Birkdale, Lancs. (Heard on November 22nd).
American: **1 ABF, 1 AFN, 1 ANH, 1 ARE, 1 ARY, 1 AWW, 1 BAL, 1 BDB, 1 BY, 1 CTJ, 1 CZV, 1 GA, 1 GOA, 1 PL, 1 SF 1 SW 1 XL, 1 XZ, 1 YZ, 2 BG, 2 BGO, 2 BLU, 2 BN 2 BO 2 BRB, 2 CGO, 2 CVU, 2 DGO, 2 DN, 2 KGG, 2 QH, 2 UD, 2 UM, 2 XQ, 3 ALX, 3 AN, 3 BDO 3 BHU, 3 BTF, 3 CHC, 3 CHG, 3 CD, 3 HH, 3 JW, 3 KMI, 3 NHF, 3 SF, 4 IO, 4 SI, 4 SO, 5 LF, 6 BJJ, 6 CGO, 6 CHL, 6 OF, 6 UF, 6 VC, 7 AFO, 7 ACY, 8 AMR, 8 AWJ, 8 CYI, 8 JQ, 8 OMJ, 8 SEY, 8 XB, 9 BCJ, 9 BDU, 9 BFN, 9 EIB, 9 XI.** Canadian: **1 AR, 1 CG, 1 DQ.** Mexican: **BX.** Various: **JFWA, FN 1, RR 8.** (o—v—o). A. H. Fielding (**2 AUI**).

Tralleborg, Sweden.
British: **2 CC, 2 TR, 5 CC, 5 CX, 5 MA, 5 MO, 5 OX, 5 NN, 6 GH,** French: **8 BM, 8 BP, 8 CPP, 8 ÉM, 8 ÉU, 8 FI, 8 GM, 8 GO, 8 GP.** Dutch: **OX, ONF,** Danish: **7 EC.** Finnish: **3 NB, 2 NCA, 2 NM.** Italian: **1 CN, IDO.** Miscellaneous: **7 AB, EST.** B. Agren and E. Sjostrom (**SMYR**).

Lichfield, Staffs. (Below 120 metres.) Since September 7th.
British: **2 JF, 2 JX, 2 KF, 2 KW, 2 NM, 2 CD, 2 EZ, 2 TF, 2 VW, 2 WD, 5 GF, 5 GS, 5 IG, 5 LF, 5 NN, 5 SJ, 5 UQ, 6 EL, 6 UD.** French: **8 AB, 8 AQ, 8 AU, 8 EF, 8 IM, 8 IN, 8 IP, 8 IS, 8 LO, 8 DP, 8 ÉM, 8 ÉV, 8 GC, 8 HIM, 8 MN, 8 PA, 8 SIF, 8 SU, 8 WAL, 8 WZ, UFT 2.** American: **1 AEI, 1 ER, 1 GV, 1 IW, 8 CC, 8 CM, 8 CN, 8 DP, 8 DU, 8 EI, 8 EM, 8 EU, 8 FC, 8 FK, 8 FQ, 8 GK, 8 GO, 8 GP, 8 HSG, 8 HSM, 8 LLO, 8 MG, 8 MN, 8 NS, 8 PA, 8 SM, 8 SR, 8 XR, 8 ZM, 8 ZZ, 10KZ.** Belgian: **4 AU, 4 AX, 4 RS, 4 SS.** Dutch: **0 MS, 0 RE, 0 XF, 0 ZZ.** Finnish: **2 NCA, 2 NM, 3 NB.** Miscellaneous: **1 CAA, 3 CM, 3 AF, 1 ER, 9 AD, ACD, 7 EC, FN 1, B 7, SMYY. WGH.** (November 8th to 23rd). American: (All between 2.45-8.30 G.M.T., November 23rd): **1 AJA, 1 ANA, 1 ECQ, 1 CAB, 1 CK, 1 CMP, 1 DQ, 1 GV, 1 KC, 1 PC, 1 PL, 1 FY, 1 SF, 2 AWF, 2 BG, 2 ER, 2 BSC, 3 AJD, 3 BCO, 3 BCF, 3 BSS, 3 CH, 3 EQ, 3 SUF, 4 IO, 4 KU, 4 TJ, 5 SI, 8 ACL, 8 DHW, 8 GZ, 8 XK, 9 AC.** (o—v—2.) Stanley F. Evans.



The transmitting apparatus at **G 2 WJ**, *owned and operated by Mr. R. L. Royle, of Palmer's Green, London.* **2 WJ** *works frequently with U.S. amateurs.*

Mosul, Mesopotamia. (November 8th, 1924): **3 CM, SMYY.** (November 10th, 1924): **2 XA, 2 NC, F 8B** (working **JFWA**). All R 7 on single detector valve. R. F. Durrant.

Gt. Shelford, Cambs.
(November 2nd, 1924): **5 RW, 0 BMA, 8 CM, 0 RB, 8 GM, 8 IM.** (November 7th, 1924): **6 KK, 6 GH, 5 UL,** (November 9th, 1924): **2 NB,** (November 8th, 1924): **FNI, 4 AL, 8 NG, 4 CA.** (November 14th, 1924): **8 SSC.** (November 15th, 1924): **8 UU, 7 MR, NOGC, 2 7Q, 0 RE, SS4, 2 DR, 6 XG, 8 GI, 4 AX, 8 DU, CMSE,** (November 16th, 1924): **8 SG, 4 YZ, 5 SU, 2 SQ, 6 GM, 2 MX, 1 JXK.** (November 19th, 1924): **8 GK, 8 SM, 2 WJ, 2 BBK, 6 TM, 2 MD, 2 AC, 5 NH, 2 MZ.** (November 21st, 1924): **6 NF, 2 VW, 8 BF, 4 AG, LP 8, 2 OD, 6 AP, 1 GV, 1 II, 2 CG.** (o—v—2.) Gerald A. Jeapes (**2 AUL**).

Whitley Bay, Northumberland (Below 120 metres.)
British: **2 CC, 2 EX, 2 KF, 2 NM, 2 OD, 5 GS, 5 NN, 5 OT, 5 UQ, 6 AH, 6 FG, 6 NF, 6 XG, 6 XJ.** French: **8 AB, 8 AM, 8 BF, 1 XAV, 2 BRB, 2 CRP, 2 FD, 3 AJD, 3 AYA, 3 BDO, 4 IJ, 8 BGN.** Swedish: **SMYY, SM2V, SM2Y, SM2Z.** Dutch: **0 AA, 0 BD, 0 ZZ.** Danish: **7 ZM, 7 EB.** Finnish: **2 NM.** Various: **3 LG, 3 AF, 3 CM, WGH, AGA.** G. S. Samways (**6 OH**).

UNKNOWN CALLS.

The following unidentified calls have been heard by readers. Information leading to their identification would be welcomed. **YW 4** (Heard in Alexandria); **W1 BHN** (heard at Verviers, Belgium); **AIN** (heard at Lymm, Cheshire); **G 6GH, G5 PP.**

Reports Wanted.

Reports on his signals are welcomed by Mr. E. Brady (**6 IG**), of 6 Cottsgate Hill, Ripon. **6 IG** transmits on 150 metres, C.W.

2 SP.

Mr. Lawrence Mansfield (**2 SP**) wishes it to be announced that he has changed his address to 34 Bath Street, Southport.

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NEW ZEALAND AMATEUR TRANSMITTERS.

The following list of call signs and addresses of amateur transmitters in New Zealand is published in response to the large number of requests we have received from readers.

1 AA	C. N. Edwards, 42 Pollen Street, Grey Lynn, Auckland, N.Z.
1 AB	Penny, 11 Peary Road, Mt. Eden, Auckland, N.Z.
1 AC	L. S. Spackman, 10 Ardmore Road, Ponsonby, Auckland.
1 AH	Hartle and Gray, Hall Commerce, High Street, Auckland, N.Z.
1 AI	Charles Sievier Goodwill, Hamilton.
1 AK	Claxton, William Harry, Parawai Road, Thames.
1 AM	Hamilton Amateur Radio Club, Hamilton.
1 AO	Russell Garland White, 125 Grafton Road, Auckland, N.Z.
1 AQ	Aymer Alexander Sommerville, Thames.
1 AR	Frank Beesley Hobbs, 44 Le Arota Street, Claudelands, Hamilton, N.Z.
1 AS	Ralph Eric Grainger, 88 Clarence Street, Ponsonby, Auckland, N.Z.
1 AU	Rolf Ernest Lempriere Aubin, Auckland.
1 AV	Rolf Ernest Lampriere Aubin, "The Oaks," Parnell, Auckland, N.Z.
1 AW	Robert Maxted, Queen Street, Thames, N.Z.
1 AZ	James Reginald Therson, 17 Te Aroha Street, Claudelands, Hamilton.
1 FC	Robert Fred Douglas Burrell, Auckland.
1 FF	Vincent John Williams, 45 Valley Road, Mt. Eden, Auckland.
1 FH	James Steel, Auckland.
1 FI	Herbert W. Batty, 22 York Street, Parnell, Auckland.
1 FJ	George Henry Choules, Waiuku.
1 LA	Auckland Radio Service Ltd., Scots' Hall, Symonds Street, Auckland.
1 YB	Mr. C. H. Pearson, La Gloria Gramophones Ltd., 157 Karangahape Road, Auckland.
2 AB	Dan Wilkinson, Motueka, N.Z.
2 AC	Ivan Henry O'Meara, 209 Harris Street, Gisborne.
2 AC	Percy Ronald Stevens, Gisborne.
2 AE	Robert James, Gisborne.
2 AF	William John Sinclair, c/o W. Sinclair & Co., electrical engineers, P.O. Box 227, Gisborne.
2 AH	Wanganui Amateur Radio Club, Gordon S. Bissett, Hon. Sec., P.O. Box 423, Wanganui, N.Z. Station: Y.M.C.A. Buildings.
2 AI	Walter Leslie Harrison, 47 Austin Street, Wellington, N.Z.
2 AJ	Henry Bransgrove, Broadway, Stratford.
2 AK	Leslie Rowson, 99 Victoria Street, Hawera.
2 AL	A. C. Cooper, 3 Cecil Street, Ashfield.
2 AM	Dr. William Fred Buist, Hawera.
2 AO	Gordon Albert John Brunette, Club Hotel, Opunake.
2 AP	Percy Charles Collier, 17 Taft Street, Brooklyn, Wellington.
2 AQ	Morton Wm. Coutts, Box 26, Taihape.
2 AR	Thomas R. Clarkson, 304 Nelson Street, Hastings.
2 AS	Albert Edward Simpson, Wellington.
2 AU	Ian J. Innes, Radio Road, Nelson.
2 AW	Cecil Roy Clarke, 60 Edinburgh Terrace, Wellington.
2 BC	Eric William Beale, Hastings.
2 BF	The Wilkins and Field Hardware Co., Ltd., Nelson.
2 BH	Paul Bareham, 213 Nelson Street, Hastings.
2 BI	Harry Neville Shrimpton, Brookside, Nelson.
2 BJ	Allan Evans, Wellington.
2 BL	Wellington College Radio Club, Wellington.
2 BO	Ercel Mervyn Gofle, Gisborne.
2 BQ	Edmund Dolbel Edmundson, Napier.
2 BR	Kenneth Arundel Lambert, Wanganui.
2 XB	Physics Dept., Victoria University College, Wellington.
2 YM	Gisborne Radio Co., Gisborne.
3 AA	Reginald John Orbell, Christchurch.
3 AB	Francis Vincent, Christchurch.
3 AC	Radio Society of Christchurch, 158 Manchester Street, Christchurch.
3 AD	Blake, R. G. F., Blaketown, Greymouth.
3 AF	Leonard Francis Ball, 90 Nursery Road, Linwood, Christchurch.
3 AH	Henry B. Courtis, 69 Grey Road, Timaru.
3 AK	Ernest Reynolds, Ashburton.
3 AL	Wilfred Milne Dawson, 263 Wills Street, Ashburton.
3 AM	Bernard Tyndall Withers, Christchurch.
3 AQ	James Ingram Smail, 188 Hereford Street and 263 High Street, Christchurch, N.Z.
3 AR	David Wm. Buchanan, 74 Wills Street, Ashburton.
3 AS	Ian James McLean Paterson, Timaru.
3 CA	H. W. Lavallin-Puxley, Farnleigh, Ealing.
3 CB	Clyde Romer Hughes Taylor, 45 Weston Road, St. Albans, Christchurch.
3 CF	Albert E. H. Simpson, 99 Amberley Road, Christchurch.
3 CG	Harold Phillip Vincent Brown, Christchurch.
4 AA	Frank D. Bell, Palmerston South.
4 AB	Otago Radio Association Incorp., P.O. Box 660, Dunedin.
4 AC	Robert Edward Robinson, Dunedin.
4 AD	Arthur Edward Jordan, 17 Biggar Street, Invercargill.
4 AG	Ralph Slade, 15 Harbour Terrace, Dunedin.
4 AH	Ian Sinclair Macdonald, 45 Royal Terrace, Dunedin.
4 AJ	Claude Norman Douglas McGregor, 131 Engleton Road, Mornington, Dunedin.
4 AK	William L. Shile, Post Office Box 519, Dunedin.
4 AL	Arnold Henry McLeod Crubb, 53 Sligo Terrace, Roslyn, Dunedin.
4 AM	William McGill, Crockett, Palmerston.
4 AO	Thomas Edward Scott, Dunedin.
4 AP	Invercargill Amateur Radio Club, Hallenstein's Buildings Invercargill.
4 AR	W. Grey Wilkinson, 21 Melrose Street, Rosedin.
4 XO	Professor Robert Jack (for University of Otago), Dunedin
4 YA	British Electrical & Engineering Co., Dunedin
4 YO	Radio Supply Co., Dunedin.

CKAC'S ACKNOWLEDGEMENT.

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6.30 p.m. Musical item.
Monday
Wednesday
Friday
1.45 p.m. Classical concert.
8.30 p.m. Dance orchestra.
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Saturday
7 p.m. Kiddies stories in French & English.
7.30 p.m. Classical concert.
8.30 p.m. La Presse studio entertainment. Specials.
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Sunday . . . . 4.30 p.m. Sacred concert.
Midnight, Fridays . . . . First and third Wednesdays of each month at 12.30 a.m.
LA PRESSE is the National French Canadian Newspaper and the largest circulated daily newspaper published in Canada.

The well-known Montreal broadcasting station issues acknowledgement cards to listeners who report reception. The above is a reproduction of a card received by Mr. A. H. Brackensey, of Finchley, London.

A. J. S. RECEIVERS.

Messrs. A. J. Stevens & Co. (1914), Ltd., of Wolverhampton, the well-known wireless manufacturers, apologise to their many customers for the delays which have recently occurred in the execution of orders. These have been due to the recent builders' strike, which has retarded the erection of additions to their wireless factory. The Company is now in a position to guarantee immediate deliveries.

BOOKS RECEIVED.

"Wireless."—By P. J. Risdon, F.R.S.A. With an introduction by J. A. Fleming, M.A., D.Sc., F.R.S. Containing many diagrams and illustrations. (London: Ward, Lock & Co., Ltd., pp. 384. Price 6s. net.)

The Book of the Wireless Valve. pp. 71 and xi. With many plates and diagrams. (London: Arks Publicity, Ltd., for the Mullard Radio Valve Co., Ltd. Price, 1s. 6d.)

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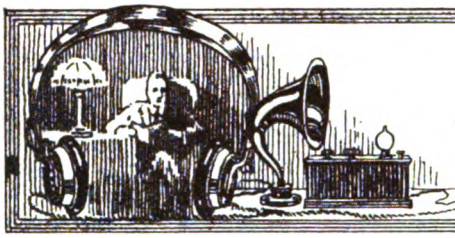

AMONG THE SOCIETIES.

Radio Society of Great Britain.

The possibilities of amateur wireless recording were dealt with by Mr. Maurice Child in his talk before the Transmitter and Relay Section on Tuesday, December 2nd, and he expressed the opinion that an opportunity existed for the amateur to evolve cheaper and less complicated methods than those at present in commercial use.

Of the two practicable methods of recording, viz., the phonograph cylinder and the tape printer, Mr. Child placed greater reliance in the latter, and outlined the various instruments operating on this principle. In all systems of recording, said Mr. Child, the use of an efficient relay was of the utmost importance and for amateur requirements the ideal instrument should be capable of working at speeds up to 25 words per minute. Such an instrument would work on the plate of a thermionic valve, and it was in the application of the valve to this purpose that the speaker emphasised the opportunity for amateur experiment.

Mr. Child then described an interesting theoretical design of his own, in which use was made of a Turner relay in conjunction with three-electrode valves.

In pointing out the comparative simplicity of recording experiments, Mr. Child alluded to the significant fact that all the early wireless apparatus was of the recording type, and he exhibited the actual Lodge-Muirhead detector used in reception twenty-four years ago. It still worked !

* * * *

A demonstration of a five-valve neutrodyne receiver was given recently by Mr. Lyon at a meeting of the Southampton and District Radio Society. British and continental stations were received at considerable strength on the loud speaker, and the efficiency of the instrument impressed all present.

* * * *

A useful service was rendered by the Wireless Section of the Morley College Scientific Society, on Wednesday, December 10th, when H.R.H. The Prince of Wales opened the new college building at 61 Westminster Bridge Road. By means of amplifiers members of the wireless section broadcast the speech to different parts of the building. The official opening was followed by an exhibition of wireless apparatus made by members.

A group of members of the Hampstead and St. Pancras Radio Society, photographed at a recent meeting.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 17th.

Radio Society of Great Britain. Eleventh Annual General Meeting. At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Photo-Electrics." By Mr. C. F. Elwell.

Institution of Electrical Engineers (North-Eastern Centre). At 7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Faraday Lecture: "World Wide Radio Telegraphy." By Prof. G. W. O. Howe, D.Sc.

Radio Research Society, Peckham. At 44 Talfourd Road. Lecture: "L.F. Transformers." Discussion: "Insulators."

Bristol and District Radio Society. Wireless Lecture No. 8. By Mr. W. A. Andrews, B.Sc.

Edinburgh and District Radio Society. At 8 p.m. At 117 George Street. Seventh General Meeting of Series.

Tottenham Wireless Society. Discussion: "Elementary Magnetism and Electricity."

THURSDAY, DECEMBER 18th.

Luton Wireless Society. At 8 p.m. At the Hitchin Road Boys' School. Exchange of Apparatus.

Beckenham and District Radio Society. At 8.20 p.m. Club Wireless Mart of Miscellaneous Gear.

West London Wireless and Experimental Association. At Belmont Road Schools. Lecture: "Use of Esperanto for Radio," by Mr. H. W. Smith, of the Chiswick Esperanto Society.

FRIDAY, DECEMBER 19th.

Bristol and District Radio Society. Lecture: "Provision of Power for Wireless Work." By Mr. H. R. Bessant, A.M.I.E.E.

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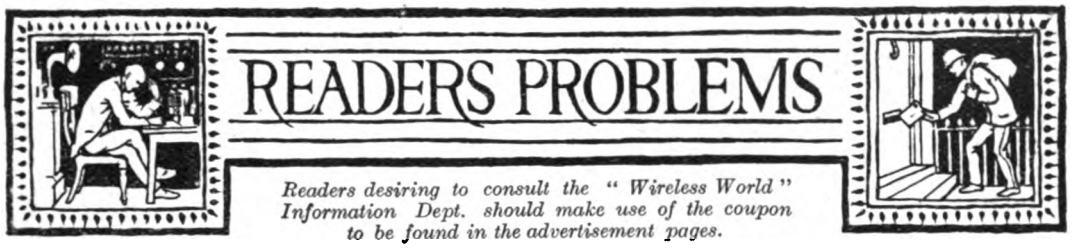
READERS PROBLEMS
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

THREE-COIL TUNERS.

A READER has noticed that in some diagrams given in this journal the secondary tuning coil is placed between the aerial and the anode coils, while in other diagrams the aerial coil is made the central coil in the holder. He asks if there is any difference between the two methods, and if so, which is correct.

Best results are obtained when the secondary tuning coil is mounted between the aerial and reaction coil, but when a "tune-stand by" switch is connected in the circuit, the aerial coil must be placed in the centre, in order that reaction may be coupled directly to this coil in the "stand-by" position. When no "tune-stand by" switch is used, we always show the secondary coil mounted between the other coils.

A method of obtaining the "tune" and "stand-by" connections without the use of a switch was described in this section of the journal for September 2nd, 1924. Terminals are provided so that the aerial and earth may be removed from the A.T.I. and connected across the end of the secondary coil, in order to give the "stand-by" connections. The reaction coil then becomes directly coupled to the aerial coil, and the only other alteration necessary is the substitution of the A.T.I. for the closed circuit coil.

MILLIAMMETERS FOR ANODE CURRENT.

INCREASING use is being made of measuring instruments in receiving sets. Voltmeters are being used to a greater extent to measure the filament voltage, as this voltage is more critical in the case of dull emitter valves. Milliammeters are also being included in the H.T. circuits, and many useful conclusions regarding the operation of the receiver can be drawn from the readings indicated. Some amateurs connect their milli-ammeters between the minus side of the H.T. battery and — L.T. This is quite wrong, unless the receiver happens to be a single-valve receiver. In a multi-valve receiver the best method would be to arrange switches, so that the meter could be connected in the plate circuit of any of the valves. In the H.F. and detector valves the value of the anode current will serve as an indication of the average grid voltage, if the H.T. voltage and the characteristic of the valve are known. In the low frequency amplifying valves, an additional purpose is served by the milliammeter. When signals are being received there should be no appreciable movement of the pointer. If the anode current changes from its normal value distortion is taking place through rectification. The trouble may be cured by readjusting the grid bias, but if this measure is unsuccessful, a higher value of H.T. or the use of a valve of larger capacity is indicated.

"SPADE" TUNING.

A METHOD of tuning which is becoming increasingly popular on account of its simplicity depends for its action upon the eddy currents set up in a metal conductor placed in the field surrounding the tuning coil. When a disc of high conductivity metal, such as copper, is placed at the side of a duolateral or basket-type coil, the eddy currents produced in the copper also produce a high frequency magnetic field in opposition to the field surrounding the coil. A reduction in the number of lines of force threading the coil is thereby brought about, and its inductance and the wavelength received are correspondingly reduced.

In designing tuning coils for spade tuning, the total number of turns in the coil must be arranged to give the maximum wavelength required, instead of the minimum wavelength, as in the case of tuning by means of a variable condenser. Thus, for the B.B.C. band of wavelengths between 300 and 500 metres, a No. 75 coil would have to be used in the aerial circuit, assuming that the aerial has an effective capacity of 0·0003 μF. The amount by which the wavelength is reduced will depend, of course, upon the position, area, and thickness of the copper tuning plates. The closer the tuning plates are coupled to the coil, the greater will be the reduction of wavelength.

A DISTORTIONLESS LOUD SPEAKER RECEIVER.

A CORRESPONDENT living within a few miles of a main B.B.C. station in a position where he obtains excellent 'phone signals on his home-made crystal set has written to ask for a circuit that will give him really distortionless loud speaker results on his local station. He has tried an ordinary two-valve amplifier, using "R" type valves, purchased

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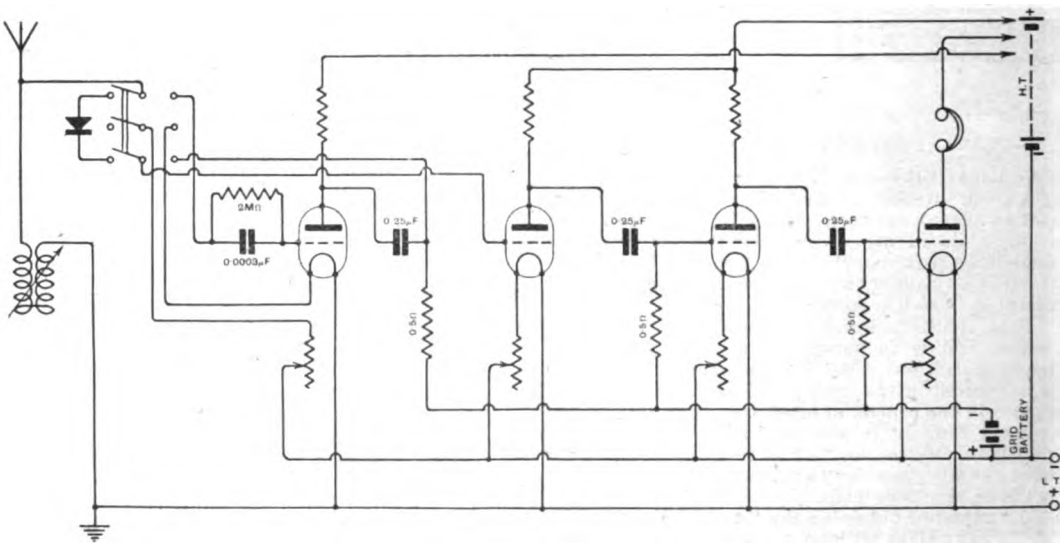
locally, and is extremely dissatisfied with the quality, and asks if it is possible to design a set to give him the results he desires, and not to give results "reminiscent of a 1905 gramophone."

A well-designed amplifier used in conjunction with correctly designed valves and transformers, and with correct adjustment of filament temperature, H.T. voltage and grid bias will give excellent results, and if they are passed to a loud speaker of good make, will give results far clearer and more natural than the best gramophone yet produced. It is, of course, essential that the amplifier receives the signals from the detector valve in an undistorted state. Signals received from distant stations are unfortunately liable to be spoilt by extraneous noises such as "mush" from high powered arc stations, atmospherics, and other noises picked up, owing to the sensitive state in which it is necessary to bring the receiver, in order to obtain good signal strength from the distant station. If extreme purity is desired, therefore, it is advisable to confine one's attentions to the local station, and thus the use of excessive reaction, with its accompanying distortion effects is avoided. If sufficiently near, a valve detector with no reaction whatsoever can be employed, or even a crystal detector, which will eliminate the slight distortion due to the usual grid condenser and leak method of rectification.

The chief causes of distortion are threefold. First, the use of "R" valves for amplification; distortion being caused by the fact that they have not a sufficient straight line length of grid volts—anode current curve, strong signals causing them to work partially on the bend of the curve, with disastrous results to purity. Secondly, the use of transformers not having a sufficiently high impedance primary winding, especially after the detector valve. A high impedance transformer usually has, owing to necessities of mechanical design, a low ratio, but unfortunately it does not follow that all low ratio transformers on the market have a high impedance. Thirdly, the incorrect use of H.T. voltage and grid bias; it is important to remember that H.T. voltage and grid bias are correlative, it being equally incorrect to use too much grid bias with a given H.T. voltage, as it is to use too little.

It is quite possible to obtain distortionless amplification without resistance coupling, with its attendant high anode voltage and low amplification value, by first choosing the correct valves and then choosing transformers to work in harmony with them.



A distortionless loud speaker receiver.

It must not be thought that resistance coupling is a panacea for all distortion. Unless the correct values of resistance, coupling condenser and leak are chosen, distortion will still occur. Speaking generally, it is first necessary to choose the value of anode resistance according to the valve used, and then to use a large value coupling condenser and a low value leak.

As our correspondent is very emphatic on the point of purity, we illustrate above a suitable resistance-coupled amplifier employing either a valve or crystal detector as required. No reaction is used. Suggested condenser and leak values are marked. It is recommended that type D.E. 5B valves be used, as these valves are specially designed for the purpose, and since they possess a high amplification factor, not so much loss of amplification will be experienced. It is essential, however, that the final valve be of the D.E. 5 type, and not D.E. 5B. There is, however, no harm in employing a D.E. 5B as detector valve if desired, provided that the anode voltage is suitably adjusted. Separate H.T. tappings are provided. With regard to loud speakers, there are many excellent types on the market. If the "megaphone" effect of a horn is objected to, there are excellent hornless loud speakers that can now be obtained in this country.

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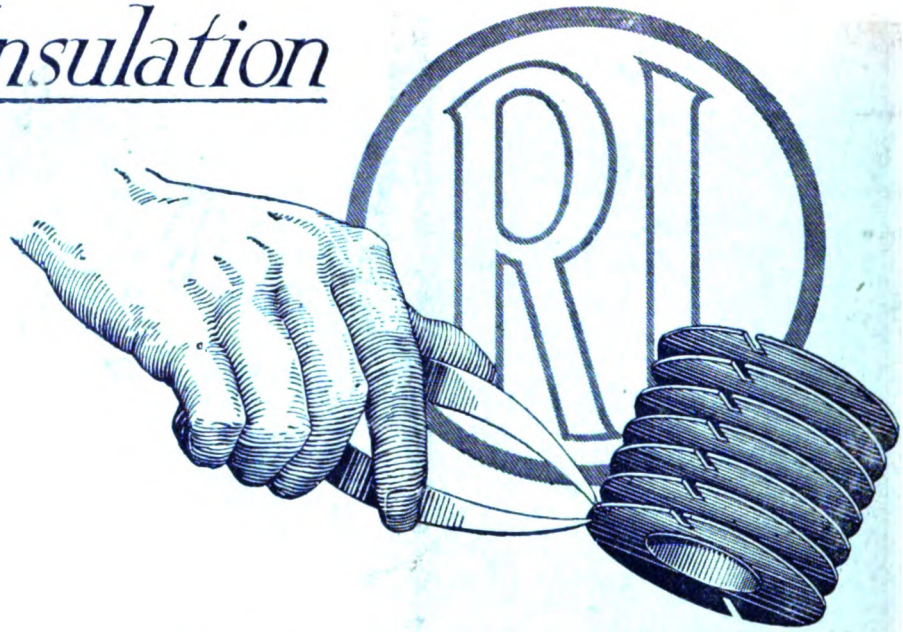

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TWO-COIL
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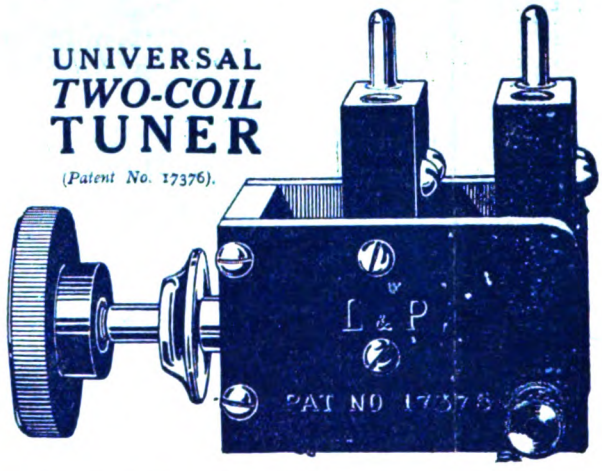

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

By The Editor.

THE SHORTAGE OF APPARATUS.

In a recent editorial note we referred to the responsibility of the manufacturers in connection with the poor quality and defects in some apparatus which might produce symptoms in completed sets difficult to diagnose by any but experienced amateurs. There is a further responsibility of the manufacturers, more than ever in evidence at the present time, which, through lack of foresight or from some other contributing cause, many manufacturers have failed to meet.

During past months there has been a steadily increasing shortage of a large proportion of the essential components of receivers which in the past the public have depended upon manufacturers to supply for their requirements. Perhaps it is on account of the Christmas season that an abnormal demand has been created, but this seems a poor excuse when one takes into consideration the fact that the manufacturers, and particularly some of those who are responsible for the greatest shortages of apparatus, have already had the experience of several Christmas seasons, and the present shortage in supply has been steadily increasing over many months. In addition to past experience the manufacturers have had access to a very definite indication of the increase in demand if they had cared to study the figures for licences issued. What is, perhaps, the most regrettable point about the situation which has arisen is that the public has found that it is impossible, without a very long delay, to obtain components by the best manufacturers, whereas the supply of inferior materials is in many cases kept up on an adequate scale by less experienced and unreliable manufacturers. This only tends to result in disappointment amongst the public at the results which they afterwards obtain from sets so constructed. In desperation they cannot turn to complete sets even if their pockets can afford these, for the position is almost as serious with regard to the supply of complete sets, and it surely is not satisfactory to a prospective customer to be informed early in December that the set he wishes to buy as a Christmas gift can be delivered to him somewhere towards the end of January if he places his order at once.

It is no wonder that manufacturers of valves have thought fit to maintain their prices up till now, because we cannot imagine what would happen in the rush for sets and components if a substantial reduction in the price of valves were suddenly introduced. We are quite prepared to admit that a certain amount of caution in manufacturing commitments is desirable, but we believe that British manufacturers have adopted a policy of caution which is beyond all reason, and we fear that unless some radical change is brought about in order to increase the supply in proportion to the demand, that competition from abroad will soon rob the home industry of a large proportion of the business which has been heaped up on the doorsteps of British manufacturers.

THE RADIO SOCIETY OF GREAT BRITAIN.

The announcement of the acceptance by Sir Oliver Lodge of the Presidency of the Radio Society of Great Britain is a matter on which

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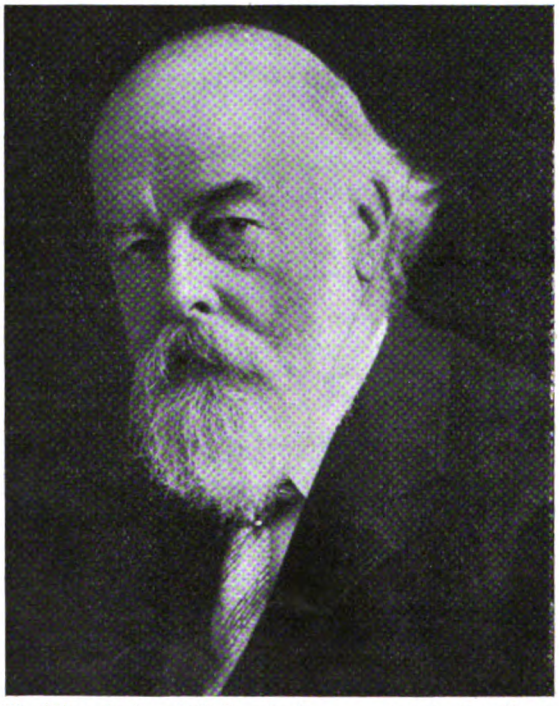
the Society may well congratulate itself. The name of Sir Oliver Lodge ranks with the highest names associated with the development of wireless telegraphy and his contributions to the science are of such importance that the name Lodge must always remain inseparable from that of wireless.

The Society has in the past set itself a high standard in its choice of leaders and all those whose names have been associated with the Society as Presidents in the past must feel gratified that the continuance of their work has been undertaken by so illustrious a successor.

It would not be fitting on this occasion to omit a reference to the inestimable services rendered to the Society and to the entire amateur community by the retiring President, Dr. W. H. Eccles, whose task is relinquished, after two years of office, in deference to the rules of the Society in the framing of which, under the new constitution, he has played so important a part.



Sir Oliver Lodge, F.R.S., who has accepted the Presidency of the Radio Society of Great Britain for the coming year.

The development of wireless and its extended application to broadcasting brought about the necessity for a radical reorganisation of the Society's affairs and an extension of its activities. After broadcasting started the Society grew out of its older and less flexibile constitution. It was under the Presidency of Dr. Eccles that the urgent need for action was recognised and as the leader of the amateur community he lost no time in setting in motion the wheels which have for two years been busy in bringing about the necessary changes to enable the Society to cope with the altered situation. Dr. Eccles can now feel that most of his task is completed yet at the same time the Society will not readily part with his services and it is to be hoped that, as the retiring President, his seat on the Committee reserved for him as the immediate past President will seldom be vacant at the deliberations of the Council.

There is no doubt that important events of interest to the amateur will transpire during the coming year, and much work lies ahead for the Radio Society. With the growing interest displayed by commercial companies, the Government and the Services, in the short wavelengths, it will not be easy for the amateur to retain his claim to the use of a short wavelength band for transmissions unless a good case is made out on his behalf.

A few days ago the Postmaster-General made the disclosure in the House of Commons that a Bill has been drafted and will shortly come before the House which will modify the terms of the "Wireless Telegraphy Act of 1904," and it seems more than probable that the purpose of the Bill will be to give greater powers to the Postmaster-General in the matter of the granting of amateur and experimental licences, especially for purposes of transmission.

Every amateur should take steps to inform himself of the exact situation so that he may be in a position to give accurate and sound advice to those with whom he comes in contact. It is only by educating the public that a fair consideration of the amateurs' case can be assured. The Radio Society must receive the fullest support from the amateur community in their efforts to maintain the rights of the experimenter.

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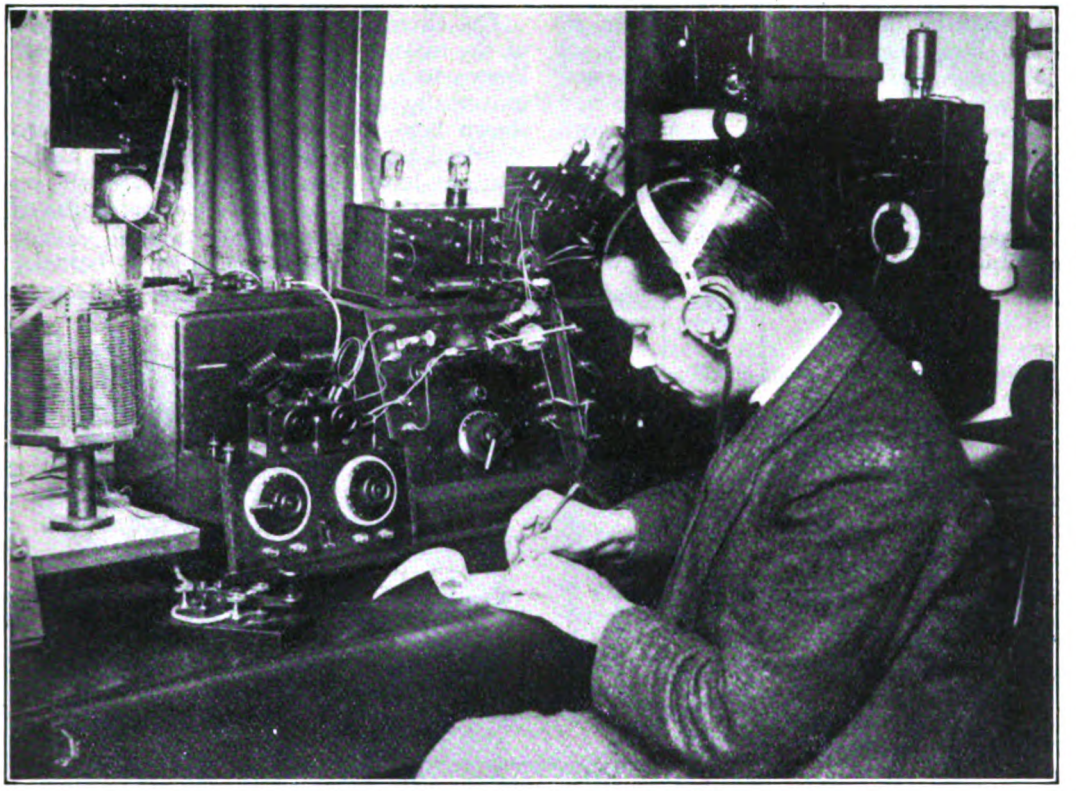

Mr. Simmonds operating at 2 OD

BRITISH 2 OD

A DESCRIPTION OF THE STATION OF MR. E. J. SIMMONDS.

Among the English amateur stations conducting communication tests with the Antipodes, 2 OD, situated at Gerrard's Cross and operated by Mr. E. J. Simmonds, probably holds the foremost position. His achievements are of such outstanding interest that every reader is by now thoroughly acquainted with the work that has been done and it may even be said that it is the duty of every amateur to watch the progress made not only because of its scientific interest, but to assist in laying stress on an event which endorses the rights of the amateur to full facilities for conducting experimental work with transmitting equipment.

ANY commercial company would be proud of the results which the amateur workers have obtained and it is not without some surprise when onelearns that efforts should ever have been made to bridge such a vast distance. It is safe to say that all world amateur records have been broken by the British successes in these long distance tests and it is probable that it will be a long time before a new record can be set up. The distance is over 11,000 miles and the greatest span on the earth's face cannot exceed more than about 12,500 miles, so that unless stations can be selected of exact location to half encircle the world the present records must remain unbroken.

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Preceding the actual communication tests it will be remembered that Mr. Simmonds first reported hearing the signals of Mr. F. Dillon Bell, operating his station 4 AA, of Palmerston South, New Zealand. Although not actually first to establish two-way working, he got in touch with 4 AA on 20th October last and has maintained reliable working for quite long periods since that date.

Considerable interest attaches to the equipment used in establishing this world record and the controversy which exists in amateur circles regarding the best circuit system to employ is for the time being solved, as there is little doubt that many experimenters will duplicate in some of its details the equipment at 2 OD, particularly as far as it applies to their own circumstances. Transmitting equipment cannot follow any standard circuit system as the conditions met with vary in individual cases and although one may accept a circuit arrangement which on test has produced highly satisfactory results, the operation of the transmitter, as is readily appreciated, depends for its efficiency on certain important constructional details and the method of setting up and adjusting the apparatus.

The circuit employed, Fig. 1, makes use of the master oscillator arrangement so well known to amateur transmitters and now so universally adopted. The circuit which is shown here will be seen to be an entirely standard arrangement and no unusual modifications have been introduced. It will be seen that the oscillator drive circuit comprises tuned grid and tuned anode circuits. These are not coupled and oscillation is brought about entirely by the capacity coupling present between the electrodes of the valve.

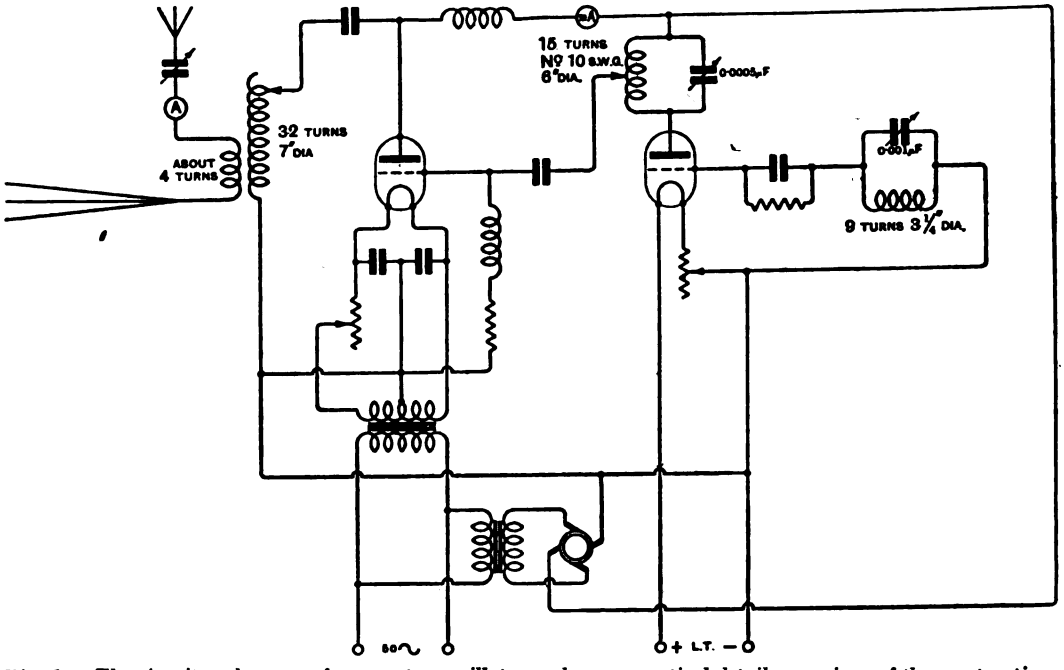

Fig. 1. The circuit makes use of a master oscillator and some practical details are given of the construction of the tuning inductances. The output terminals of the synchronous rectifier should be bridged with a suitable smoothing condenser whilst an H.F. choke may with advantage be connected in the lead to the valve plates.

The layout of the apparatus comprising the master oscillator is shown in Fig. 2, where the grid coil and its tuning condenser is on the left and the anode coil with tuning condenser on the right. The valve filament resistance is between the two inductances. The construction of these coils is of interest inasmuch as the turns are almost self-supporting. They are shaped by winding on formers and threaded on strips of insulating material, drilled with suitable rows of holes. In the grid circuit, where the oscillating energy is only of a small value,

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the insulating material which forms a dielectric between the turns is of ebonite, whilst for the plate coil, where appreciable dielectric loss may occur due to the use of supports constructed from unsuitable insulating material, teak is used, having had a liberal treatment with paraffin wax. These coils will be found simple to construct and possess good rigidity, whilst a minimum of dielectric material is introduced into the electrostatic field and entirely avoiding the use of screws or other metal parts in the neighbourhood of the turns.

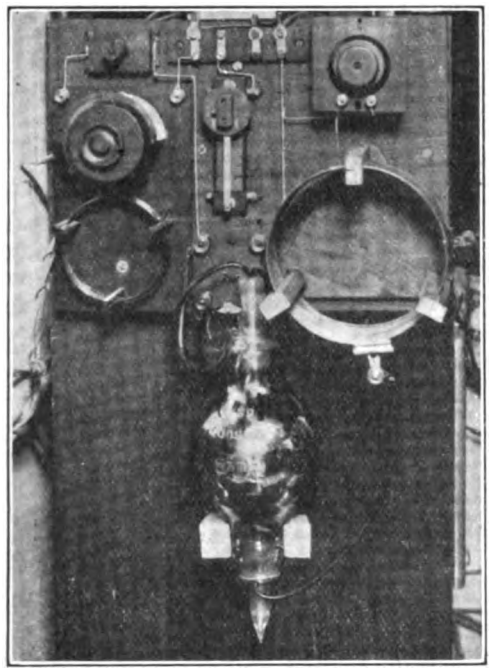

Fig. 2. The master oscillator; on the left is the grid coil and tuning condenser; on the right, the anode coil and tuning condenser.

The amplifying valve, as will be seen from the photograph in Fig. 3, is a O 250C and is operated very much below its normal output. Owing to the particularly good layout, the components here again can be readily identified. The milliammeter in the feed circuit is on the left, whilst the lead trailing across it is from a tapping point on the tuned plate circuit of the drive oscillator. The H.F. choke coil in the plate lead of the amplifying valve is immediately behind a Zenite rod, which is used to support the small condenser connected between the master oscillator and the grid of the oscillation amplifier. The meter immediately beneath the valve indicates the filament current, whilst the filament resistance is just below it. The two condensers just above the meter bridge the secondary of the filament heating transformer to provide a point on which to terminate the grid leak and oscillating circuit leads. The inductance in the plate circuit is to the right of the valve and its equipment, and consists of a winding of bare copper wire supported on a hexagonal frame. This winding is extended to the coil immediately above it, so that a few turns are linked in with the aerial inductance through the fixed coupling. A series condenser tunes the aerial and is seen in Fig. 3 immediately above the aerial ammeter.

The filament of the amplifying valve is heated by means of a step-down transformer, operating from the public supply mains. The supply is at a frequency of 50 cycles and is also made use of for providing a high tension current for the plate circuits of both oscillator and oscillation amplifier. A very simple arrangement is used for providing a high potential plate current and consists of a step-up transformer fed to a commutator rectifier revolving on the shaft of a synchronous A.C. motor (Fig. 4) with a simple filter circuit. The success of this method of deriving the H.T. supply is best judged by listening to 2 OD's transmission, when it will be observed that there is an entire absence of hum due to a rippling H.T. supply.

The send and receive change-over switch is on the right-hand side in Fig. 3 and immediately below it is the receiving tuner. Coils of high efficiency are employed here of the same type as those already described. They are almost self-supporting coils wound with enamel wire and carried upon drilled ebonite strips.

Most experimenters must have met the difficulty of making up an efficient tuner which will operate over a wide band of wavelengths. A single inductance does not tune over a very wide band and thus it becomes necessary to either adopt some system of plug and socket connector so that inductances can be interchanged or to make use of tapped coils. Mr. Simmonds prefers the former arrangement though he does not use the

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standard plug and socket coil mount. His pin connectors are widely spaced and it is interesting to observe that this coil holder is of a unique design. Its side plates are of ebonite, rigidly spaced apart by means of an ebonite spacing piece, whilst the plug and socket connectors for any one coil holder are mounted on small pieces of wood and separated by an air space. The use of air spacing has been extended as far as consist of only one or two turns, is in the aerial circuit and variable coupling is provided with a tuned closed circuit. The reaction coil is in the left-hand holder.

This tuner precedes a "QX" valve used as the detector in front of a supersonic heterodyne receiver. The receiver follows orthodox lines excepting that a novel method has been introduced of controlling self-oscillation. The intermediate stages

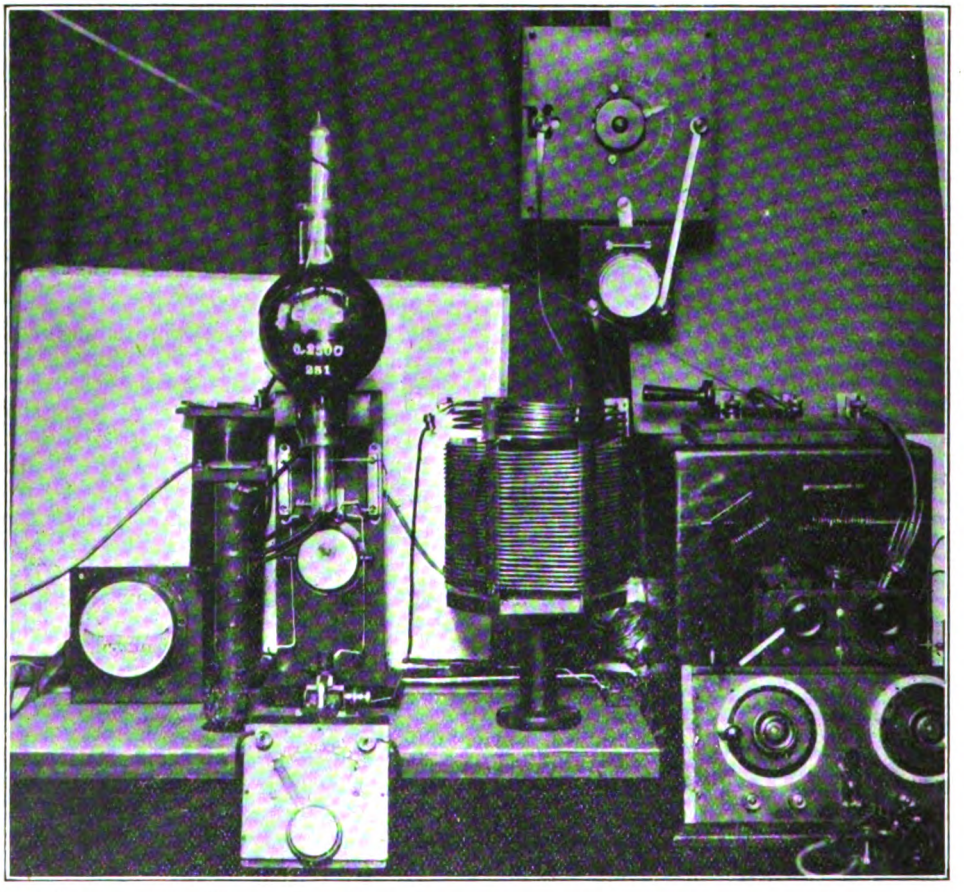

Fig. 3. The power amplifier and aerial tuning equipment. The receiving tuner and send and receive switch can be seen on right.

possible in all the apparatus employed at the station as is evidenced if one closely examines the lead-in terminal of the aerial tuning condenser in Fig. 3. It will be seen that holes have been made around the terminal to render it as far as possible "air supported." The right-hand coil in the three-coil holder, which will be seen to operating on the long wavelength are all carefully tuned by means of condensers though the second stage is controlled by a tuning condenser which can be operated from the front of the instrument. When this second amplifying stage is thrown into step with the other intermediate circuits, self-oscillation is set up in the long wave

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amplifier and by critically adjusting this tuning condenser oscillation may be controlled to a fine degree.

After the detector valve of the supersonic heterodyne receiver, two stages of low frequency amplification are available and are introduced by the operation of a switch. It is interesting to observe that these two L.F. stages are resistance coupled, the object being to entirely eliminate "transformer noise." A feature of the entire receiving apparatus is that it is perfectly silent in operation. There is an absence of background noise so that the weakest of signals can be easily read. Listening on the telephone receivers a condition of entire silence exists until a signal is tuned in and however weak that signal may be, no great difficulty is experienced in reading it, as there are no interfering sounds. To further eliminate any chance of interfering noises arising in the receiver, H.T. accumulators are employed for supplying anode potential to the receiving valves and these are charged from the A.C. supply by means of "S" tube rectifiers. The filament heating and other low voltage accumulators are also charged from the A.C. mains by means of a home constructed vibrator rectifier.

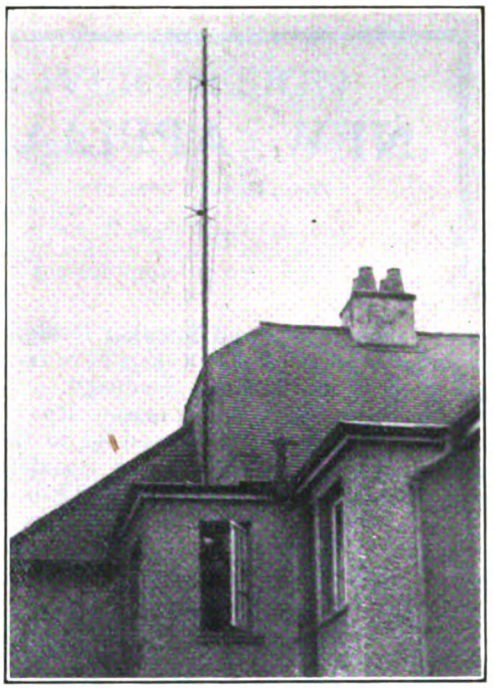

Fig. 5. The short mast to elevate the aerial at the leading-in end.

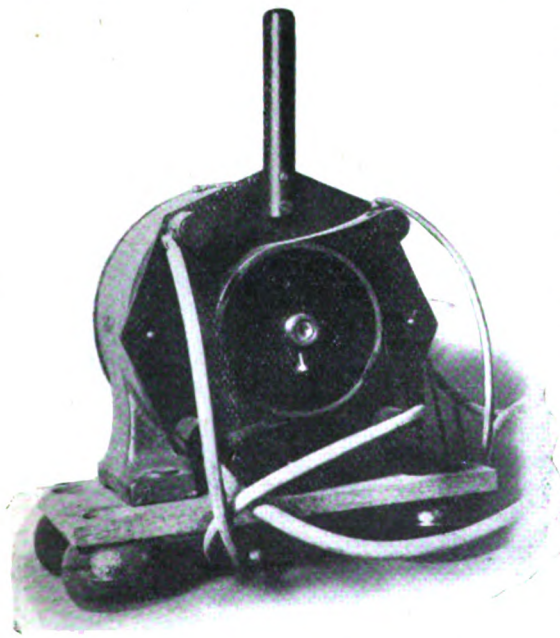

Fig. 4. The mechanical rectifier consisting of a commutator mounted on the shaft of a synchronous motor. It is supported on balls of "Sorbo" india-rubber to eliminate vibration.

On examining the aerial system one is a little surprised to learn that such enormous distances can be covered with an aerial of such modest dimensions. A mast, Fig. 5, is attached to the house to a height of only 10 ft. above the roof and carries a small cage aerial. The far end is supported in a tree a short distance away, while the foliage reaches to a height greater than that of the aerial. The earth screen consists of six wires spread out in fan formation about 7 ft. above the surface of the ground.

To summarise the successful working of 2 OD we might mention that Mr. Dillon Bell, operator at 4 AA in New Zealand, states that 2 OD's signals are easier to read than those of any other British station, while other New Zealanders worked include 4 AG and 2 AC.

Australian stations with whom reliable communication has been established are 3 BQ, 2 DS and 2 CM. Two-way working has also been carried out with the American station 5 UK which is the only American 5th district station that has established two-way communication with England.

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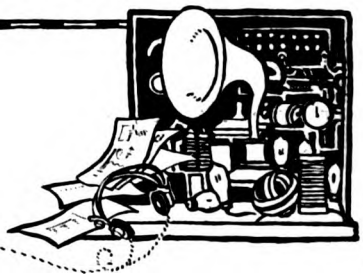
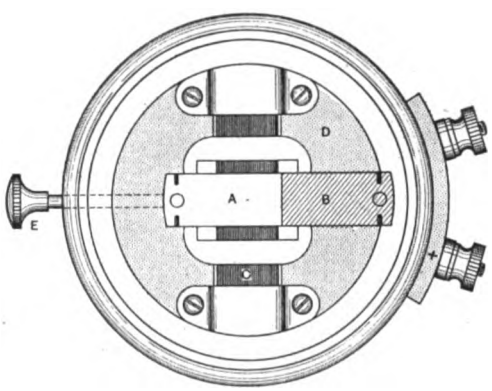
NEW APPLIANCES.



Novel Features in Loud Speaker Design.

Two new types of loud speakers have been introduced by the Ediswan Company.

One is of particular interest inasmuch as an entirely new device has been added to the magnetic system. It consists of a sliding metal piece composed half of brass and half of soft iron. Its movement is controlled by a knob on the side of the instrument and the iron piece can be made to move between the poles of the magnet. The manufacturers claim that this device, which they describe as a modulator, has the property of removing the "tinniness," "rattle" or "blasting" so often present in loud speaker reproduction. According to the makers' instructions the diaphragm, which is adjustable and is mounted in a ring, is brought down to almost make contact with the pole pieces, after which, by bringing the piece of soft iron into position across the pole pieces, the pull on the diaphragm is released and an adjustment obtained where distortion is reproduced to a minimum.



The "Televox" loud speaker. A and B are the pieces of soft iron and brass which may be moved between the poles C of the magnet D by knob E.

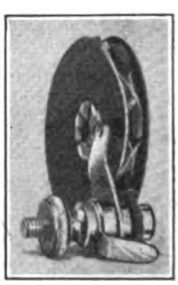
The movable piece of iron, which may be termed a "keeper," closes the entire magnetic circuit and thus controls the amount of sound emitted by the instrument. This loud speaker appears under the name of the "Televox" and is particularly beautiful in its appearance, being given a black and gilt finish.

The other loud speaker which is marketed under the name of the "Dulcivox," is of the more usual pattern and has its diaphragm fixed in position, while the pole pieces are adjustable by means of a milled screw. This instrument also has a particularly attractive finish.

The standard winding for both instruments is to a resistance of 2,000 ohms.

Useful Adjustable Resistance for Dull Emitters.

The difficulty with regard to the use of both bright and dull emitter valves in a receiving set has been overcome by the introduction of a little device sold under the name of the Lissenstat "Resistor." It consists of a winding of insulated resistance wire in basket coil formation and fitted with protecting covers on back and front. A hole in the centre provides for easy mounting. The winding has a total resistance of about 35 ohms and is variable by means of an arm which moves smoothly over the turns. When inserted in series with the usual filament resistance used with bright emitter valves it is easily brought into operation by moving the arm across the turns so that suitable resistance values can be obtained to suit almost any type of dull emitter.



The Lissenstat "Resistor."

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PROGRESS IN RECEIVER DESIGN

A review of the developments of the past few years shows that many advancements have been made, some of which under the test of time no longer assume the importance with which they were heralded, while others have proved to become standard practice.

It is the purpose of this article to sum up those developments and incorporate the best of them in a receiver designed entirely to give as perfect reception of broadcast as modern circuits and apparatus can provide.

By F. H. HAYNES.

THE thinking amateur hesitates when drawing up a design for a set which he hopes will be the last word in receiver construction because he appreciates that so much of his component apparatus is by no means perfect. His less experienced confrère, also, is in very much the same position, having gained his knowledge by a perusal of articles on the subject in which the one object of their authors may not have been to guide him on the smoothest path but to centre attention on some device which to the beginner would appear to have not been hitherto described. We stop to think in these times, when developments seem to follow one another so rapidly, before locking up costly equipment in any particular design, yet the writer, in no way wishing to convey that receiver design has come to a halt, feels that at the present stage an instrument can be built so nearing perfection that it will remain standard for some time to come.

The circuit arrangement is here discussed under headings so that a careful analysis can be made.

THE AERIAL TUNING SYSTEM.

In setting up the aerial circuit a choice must be made from among a number of tuning arrangements, bearing in mind that the efficient tuning range should be from 200 to 3,000 metres.

For the shorter wavelengths up to 600 metres and employing an aerial of the usual amateur dimensions the series tuned circuit with inductance and variable condenser recommends itself. This is extensively used for reception on the short wave broadcast band but suffers from the defect that as the capacity of the aerial system may be brought down to a low value, self-oscillation may be brought about in a manner rather difficult to control. The series condenser gives comparatively sharp tuning which is not always an advantage if a tuned high frequency stage has to be simultaneously adjusted.

As an alternative the parallel resonance circuit with the condenser connected across the ends of the inductance is often seen, yet this has the disadvantage of dropping the potential across the ends of the coil. A series parallel switch makes optional the two arrangements, but here again neither is quite suitable and there is a tuning gap when switching over.

From these considerations the use of both series and parallel condensers can be made to give sharpness of tuning, develop a maximum potential across the inductance and at the same time hold the set reasonably stable against self-oscillation.

A condenser has appeared on the market admirably suited for the purpose although designed really to give simultaneous tuning of two high frequency circuits. It consists of two condensers operated on a common spindle and this can be connected with one section in series and the other in parallel with the inductance. It gives good tuning up to wavelengths of 800 metres, when each section has a maximum capacity of about 0·0002 mfds.

The use of a condenser of this type brings with it another advantage inasmuch as the series condenser can be taken out of circuit when on the longer wavelengths, oscillation frequency may be appreciable, and thrown in parallel with the already parallel connected condenser, so increasing its maximum. The two circuits are shown in Fig. 1 at A and B, whilst the switching is given in the complete circuit diagram.

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One must not overlook when contemplating this arrangement that aerial tuning is still effected by a single dial. Condensers with cut-away plates to produce a "square-law" effect are recommended owing to the opening out of the tuning scale near the minimum.

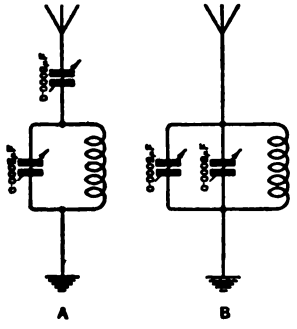

Fig. 1. Two condensers operating on a common spindle used for tuning on wavelengths up to 800 (A), *after which they are connected in parallel* (B).

The consideration arises as to whether it is advisable to introduce loose coupling with the aerial and although the writer favours such an arrangement, as it provides good selectivity and possibly improved signal strength as well as giving smooth oscillation control by varying the radiation load on the closed circuit, it adds a complication in tuning which immediately takes the operation of the set out of the hands of the inexperienced user. In discarding it, the simultaneous series parallel aerial tuning is a good substitute.

Turning to the question of the aerial inductance and as one who has gained his schooling before the introduction of plug-in coils, the writer rather favours a specially constructed single layer coil for wavelengths up to 1,000 metres, followed by a banked or basket winding for the longer wavelengths. Such coils, although possessing good efficiency, immediately limit the wave range, while they are not always easy to construct and considerable difficulty arises when it comes to devising a suitable variable coupling with other coils in the set.

It is undoubtedly the extreme utility of the plug-in coil and the three-coil holder which accounts for their extensive use. It is interesting to note that this type of coil has never become very popular in America. As to the special type selected and its adaptation, details will be given in a description of the actual set to be given later.

HIGH FREQUENCY AMPLIFICATION.

The provision of high frequency amplification is essential if the set is to be capable of receiving any other than local transmission. An oscillating high frequency amplifier may enormously increase the range of reception, though it is not always favoured, as it produces a peculiar form of distortion. The H.F. amplifier adjusted to be on the point of oscillation is "triggered" by incoming wave trains and received oscillations may be prolonged. As a result, the varying amplitude of the wave train is not accurately reproduced at the grid of the detector valve

The tuned anode method of high frequency amplification is universally adopted and where rectification is to be brought about with a general purpose valve by means of a grid condenser and leak, a tuned anode amplifier is to be recommended.

A tuned intervalve transformer is employed when it is desired to pick up a potential possessing the necessary phase reversal for feeding back to cancel out self-oscillation. Another reason for employing transformer coupling is when anode rectification using a grid potentiometer is adopted. Again the difficulty arises with regard to constructing the transformer having fixed coupling with coils of the plug-in type. This is overcome by mounting an additional coil holder in a fixed position on the side of one of the adjustable coil holders, as shown in Fig. 2. When a suitable detector valve is employed, it is probable that better quality is maintained than when grid condenser and leak rectification is made use of.

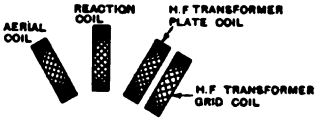

Fig. 2. Mounting of the tuning coils to provide reaction coupling with the aerial and H.F. transformer inductances.

In tuning to the wide wave range, the maximum capacity of the tuning condenser should be increased on the longer wavelengths. A large capacity tuning condenser does not give the necessary sharpness of tuning on the shorter wavelengths and for this reason a two-section condenser is again used. When the aerial switch is moved

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over to the long wave position the two sections are thrown in parallel so that a single dial provides an extensive tuning range (Fig. 4).

REACTION.

Self-oscillation can be set up by inductively linking together the aerial inductance and the high frequency transformer, but a separate reaction coil in the plate circuit of the detector valve stimulates the desirable condition of oscillation in the detector valve plate circuit and at the same time provides for separately controlling oscillation in the aerial and H.F. amplifying circuits.

seen that the secondary can be loosely coupled to the aerial and the receiver becomes a loose coupled set with tuned primary and secondary, giving a very high degree of selectivity. The reaction coil winding may be connected across with a short-circuiting plug.

The fitting of a reversing switch in the leads to the reaction coil is recommended.

LOW FREQUENCY AMPLIFICATION.

So much has been written concerning the relative merits of the three methods of low frequency intervalve coupling that little more

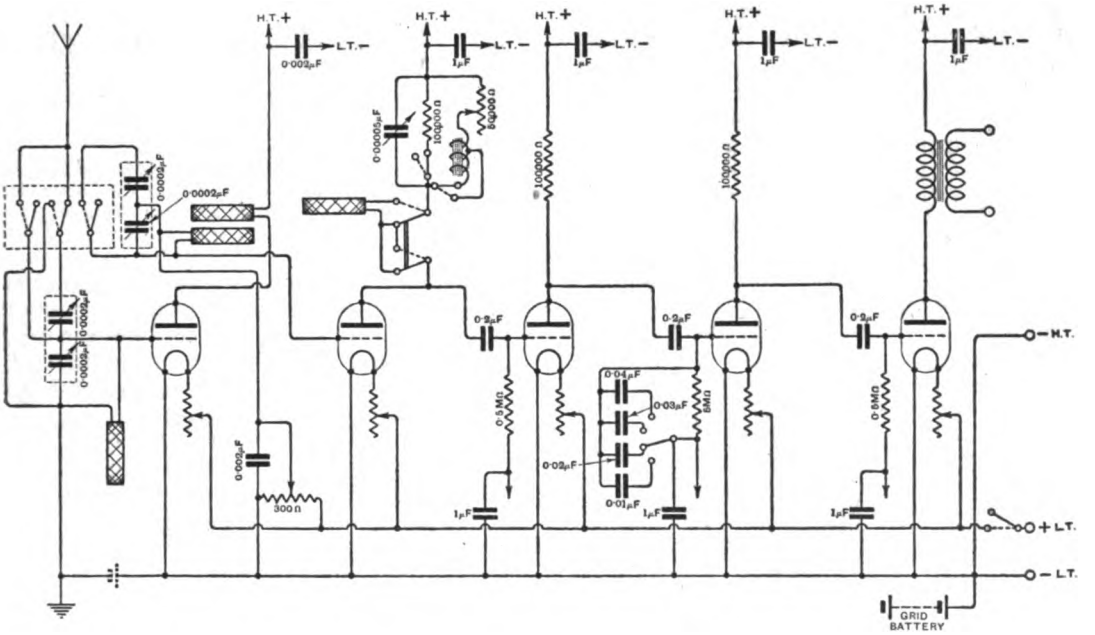

Fig. 3. The aerial and anode tuning makes use of plug-in inductances and a switch changing the wave range. The low frequency stages are essentially resistance coupled and include tone selecting devices.

Using the three-coil holder with the reaction coil mounted in the centre, some degree of self-oscillation can be stimulated in the aerial circuit where damping normally occurs, whilst the connections to the high frequency transformer may be arranged to stop oscillation as the transformer windings approach the reaction coil, for it is readily realised that the inter-electrode capacity of the H.F. valve brings about a condition of self-oscillation in the high frequency circuit. The arrangement of the coils is shown in Fig. 2 and this permits of taking the H.F. amplifier out of circuit by merely removing the transformer plate coil. It will then be

is left to be said than that each method has reached a high degree of perfection and each has its own application. Where it is desired to preserve the speech wave form and introduce a minimum degree of distortion, then it is necessary to use resistance intervalve coupling, though it is well known that an additional amplifying stage must be employed. An attempt has been made in the circuit (Fig. 3) to use resistance coupling between the detector valve and the first L.F. stage. Several difficulties arise here. In the first place the initial degree of amplification at this point is low and in consequence the output after the subsequent stages is limited, while again

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in order to make the reaction coil operative, a capacity shunt must bridge the resistance. However, the arrangement gives satisfactory results, though choke coupling as an alternative is available. The iron core choke coil serves a double purpose. In order to give even amplification it is wound to possess exceedingly high inductance value, whilst a tapping point is taken where the inductance value is only of the order of 4 or 5 henries. With such a low value inductance the higher note frequencies will develop a greater potential across its ends than the lower frequencies and in consequence, as the 50,000 ohm series resistance is taken out of circuit in stages, it becomes more operative in this respect, and has the result of giving greater amplification to those frequencies representing the higher pitched speech components. By means of a two-pole switch the entire inductance, which may be of the order of 120 henries, is brought into circuit, while the lead to the 100,000 ohm anode resistance is broken so that the intervalve coupling becomes the straightforward choke arrangement.

The subsequent stages are resistance coupled by means of 100,000 ohm non-inductive wire-wound spools possessing low capacity across their ends.

A condenser shunt circuit is fitted across the input of the second low frequency amplifying stage, variable in steps between 0·01 and 0·04 mfds. These shunt condensers offer comparatively low impedance to currents at the higher speech frequencies and as a result provide a selective control over amplification at the varying frequencies. Thus, this condenser shunt circuit permits of accentuating, if necessary, the lower notes, whilst the iron core inductance in the detector valve plate can be used to boost up the higher frequency components.

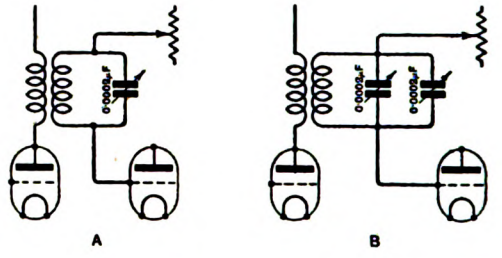
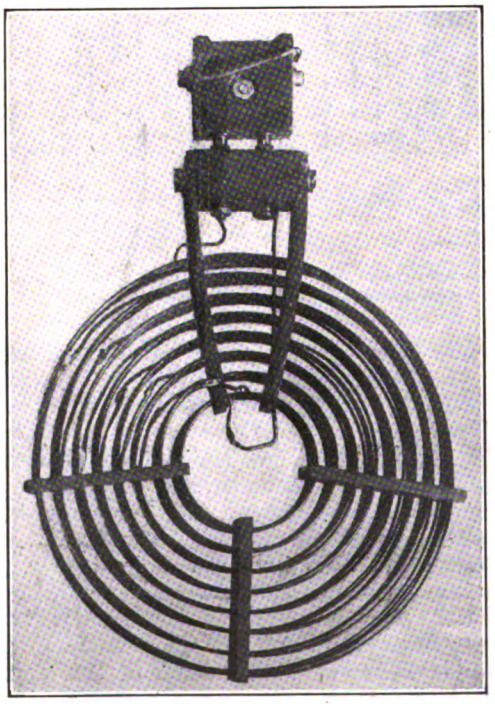


Fig. 4. The wave range switch in the aerial circuit throws the two sections of a double condenser in parallel across the H.F. transformer secondary.

The output of the last valve is fed to the loud speaker by a suitable ratio transformer and this arrangement is preferred as it separates the loud speaking equipment from a direct conductivity contact with the receiver and its amplifier.

A description will appear in an early issue of a receiver built to the circuit principle outlined here.



LOW LOSS PLUG-IN COIL.

A photograph, reproduced here, of a coil constructed by Mr. Sydney Burns to the details given in a recent article.* He has developed the design to make use of a greater number of layers than was shown in the original article.

* *Wireless World and Radio Review*, July 2nd, 1924, page 393.

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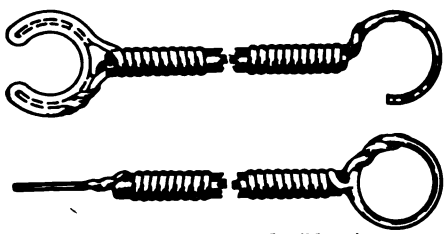
This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Terminating Flexible Wires.

FOUR different methods of providing connectors for the ends of flexible leads are shown. From the illustration it will be seen that in one method the end of the flex is tightly bound, using No. 20 tinned copper wire. Connection is made by leaving a piece of the wire projecting and soldering the flexible to it. As an alternative it can terminate as a ring or as a hook for inserting under terminals. A very rigid tag connector can be made by bending the wire back to form a double loop which, when filled in with solder, produces quite a strong connector.

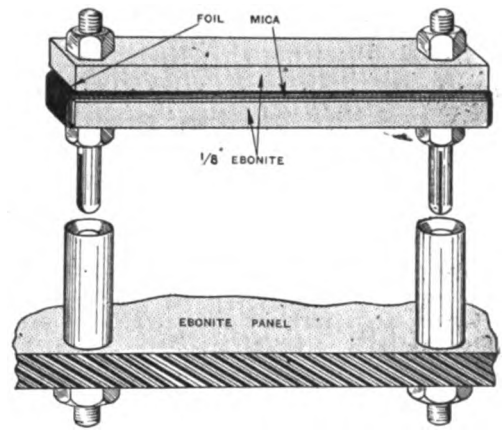
S. H.



Terminating tags for flexible wires.

Interchangeable Condensers.

WITH the usual pattern of fixed value condenser it is not always a simple process when interchanging for the purpose of producing various capacity values. A condenser made up as shown here, in which it will be seen that the plates are clamped between two pieces of ebonite held together by valve stems, provides for easy interchanging. The constructional details can be seen in the drawing and for the guidance of the beginner it might be explained that when using mica having a thickness of about 2/1000 in., that an overlap with two pieces of copper of $\frac{3}{4}$ in. by $\frac{1}{2}$ in. produces a capacity



An easily constructed interchangeable type condenser.

of approximately 0·0002 μF, providing the plates are clamped up so securely as to practically exclude air.

A. E. D.

Aerial and Earth Connections.

THREADED rods, holding ebonite plates, can be used for aerial and earth lead-in, passing through clearance holes in the window frame. Both aerial and earth leads may be terminated on plug and socket connectors which permits of easy disconnection, whilst the aerial plug can be inserted into the earth socket giving effective earthing and entirely disconnecting the receiving apparatus. This arrangement may, if

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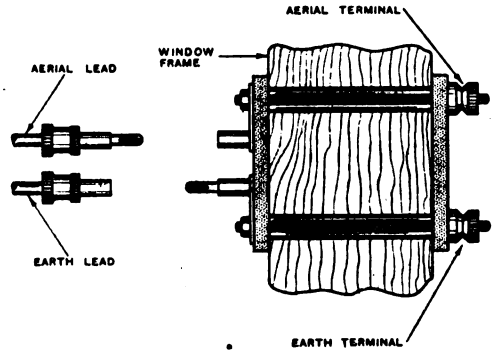
desired, be reversed so that the aerial and earth wires are connected by suitable tags to the terminals shown on the right in the diagram whilst the leads to the instrument terminate on plugs and sockets. The receiver can thus be disconnected from the aerial system and a short-circuiting plug used to connect the aerial to earth.

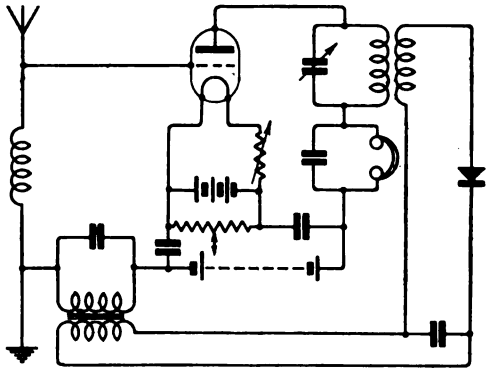
G. C.



Simple construction of aerial and earth lead-in. The aerial is earthed by withdrawing the plug and socket and linking them together.

Grid Bias.

A SAVING in weight, space and expense will often be secured by employing the method here shown of utilising the potential of the H.T. battery for the purpose of providing suitable grid bias potential. Both positive and negative potentials can be stepped off, while in the case of reflex circuits where it is desired to use a potentiometer in conjunction with a grid battery giving fine



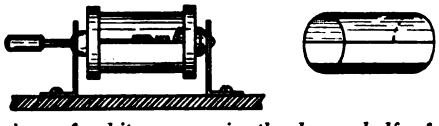
H.T. potential and grid bias from a single battery.

control over the grid voltage this method can be made use of as in the arrangement shown in the single valve circuit.

C. V. S.

A Crystal Detector Hint.

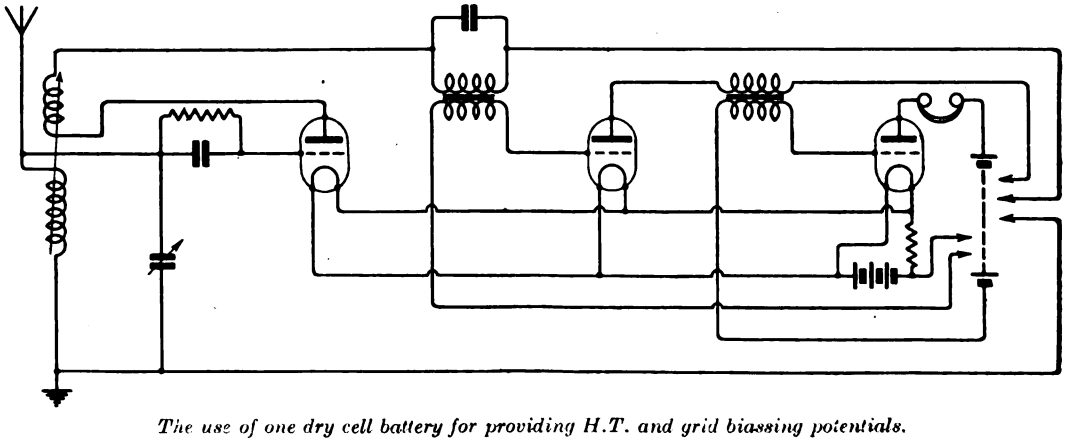
WHEN it is found difficult to see the point of contact in a crystal detector owing to the blackness of the ebonite panel



A piece of white paper in the lower half of the tube illuminates the detector contact.

beneath it, it is a good plan to insert a piece of white paper in the lower half of the glass tube, so as to throw up the outline of the contact against a white background.

A. H.



The use of one dry cell battery for providing H.T. and grid biassing potentials.

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VALVE TESTS.

MESSRS. RADIONS' LTD. "G.P." VALVE.

MESSRS. Radions, Ltd., have recently submitted for test samples of a new valve which they have developed, and which is known as the Radion "G.P."

This has been designed for general purpose use, and is quite distinct from the earlier products of this Company, the D.4 and the A.2. The electrodes are mounted vertically in a spherical bulb, which has the ruby tint peculiar to Radion valves.

The valve is rated by the makers as follows: Filament voltage 3·6-4·0; normal filament current 0·48 ampere; plate voltage 30-80.

The results of tests on the filament are shown in Fig. 1. At normal filament current a voltage of 4·25 is required, giving an emission of 4·4 milliamperes. This gives an efficiency of 2.2 milliamperes per watt, but the voltage is outside the range of a 4-volt accumulator, and a 6-volt battery and a resistance should be used.

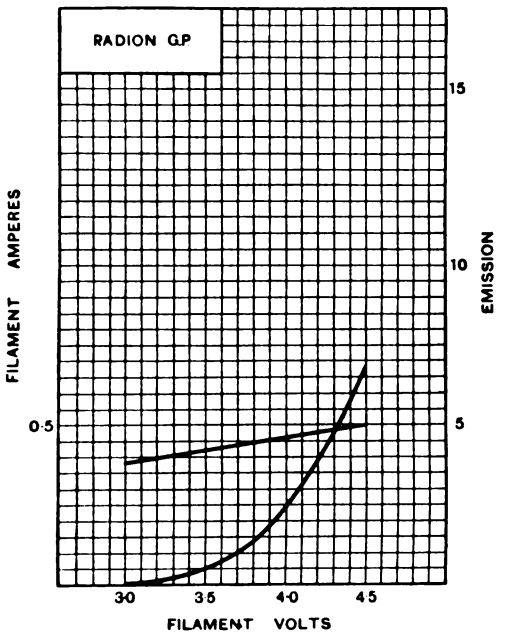

Fig. 1. Showing the filament current and emission for various filament voltages.

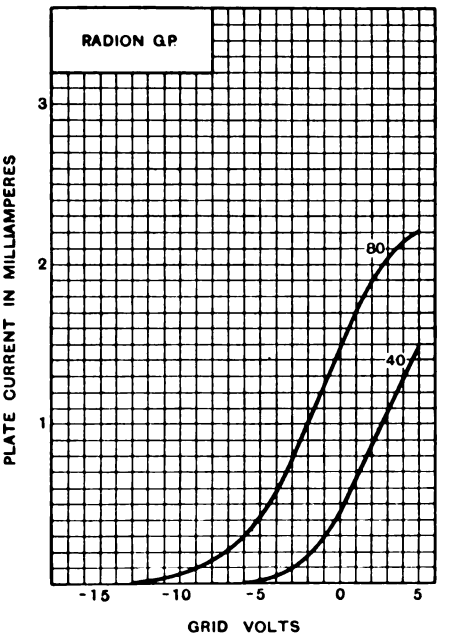

Fig. 2. Plate current-grid voltage curves.

At the maximum rated filament voltage (4) the emission is 2·5 milliamperes, which is on the low side. The filament efficiency now works out at 1·4 milliamperes per watt.

Plate current—grid volts curves are shown in Fig. 2, and the small emission is reflected in the early bend of the curve at the higher voltage. The characteristic at 80 volts, although restricted in length, has a good slope and, provided the input is small, should give good low frequency amplification. The amplification factor is of the order of 9, while the impedance varies between 50,000 and 40,000 ohms according to plate potential. The impedance is also somewhat high, and

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it was thought to be due, to a great extent, to the small emission. The truth of this assumption was proved by testing again for impedance at a higher filament voltage, when a much lower value was obtained. The filament was, of course, over-run for this test, and such an expedient is therefore not to be recommended, for the gain in efficiency is obtained at the cost of valve life.

The next test was carried out on our standard receiving arrangement, first on the high frequency side, then as a detector, and finally in the first stage of a low frequency amplifier.

The valve gives quite good results when used as a detector or high frequency amplifier, and a too careful adjustment of anode potential is not necessary, something round 40 volts being suitable. As a low frequency amplifier the high plate impedance and low emission tell against it, but even so, provided the input is small, quite satisfactory results will be obtained if this valve is used in the first stage.

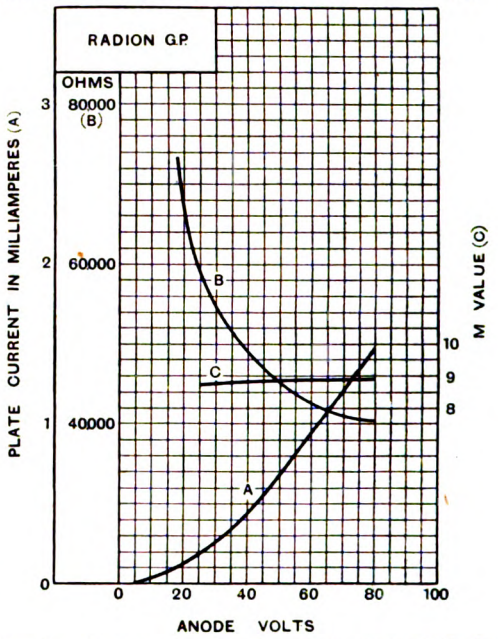
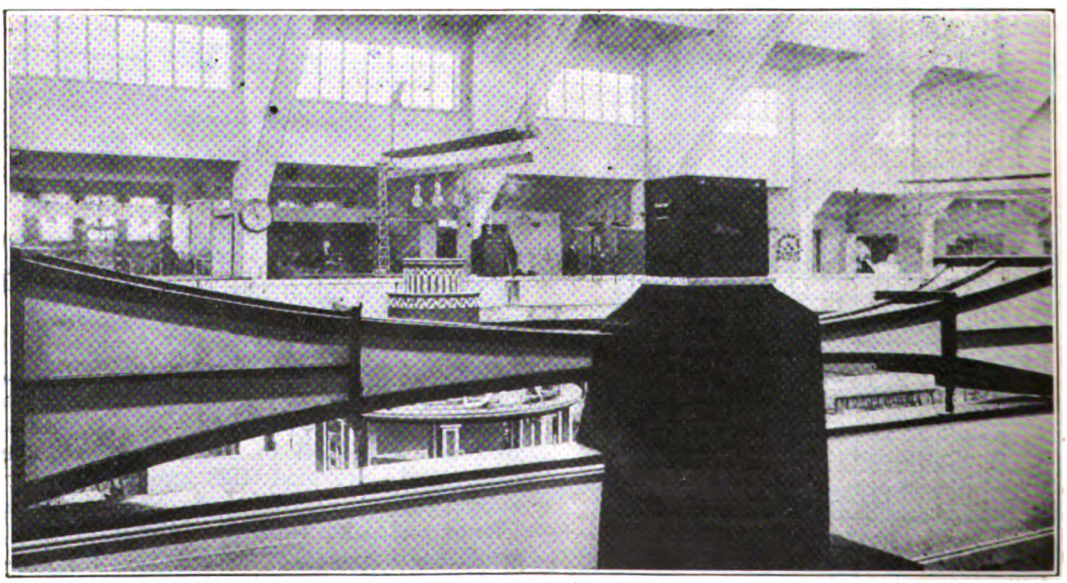


Fig. 3. Curves showing the plate current (A), impedance (B), and amplification factor (C).

A GIANT LOUD SPEAKER.



A giant loud speaker by Siemens and Halske, installed at the first German Wireless Exhibition in Berlin.

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THE EXPERIMENTER'S NOTE BOOK

By W. JAMES.

Reading Valve Curves.

WHEN studying valve curves it is useful to remember that a small change in the grid voltage is quite as effective in producing an increase (or decrease) of anode

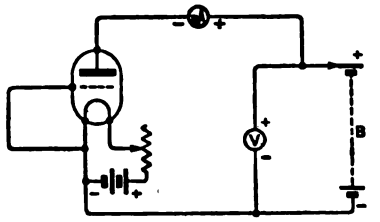

Fig. 1. Connections of the valve for finding the anode characteristic.

current as a much larger change in the anode voltage. With one valve, for instance, the anode current may be increased by the same amount by adding 1 volt (positive) to the grid as by adding 10 volts to the anode circuit. With another valve the grid may be twenty times as effective in changing the anode current, or it may, perhaps, be only five times as effective. Thus the anode current depends on the anode *and* the grid volts.

To show this more clearly let us draw two curves—one showing the relationship of anode current to anode volts with the grid at zero voltage, and the second showing the relationship of anode current to grid volts with the anode at a fixed voltage.

To obtain the information for the first curve connect to the valve, as shown in Fig. 1, the usual filament heating battery, a high tension battery B which can be tapped, and a

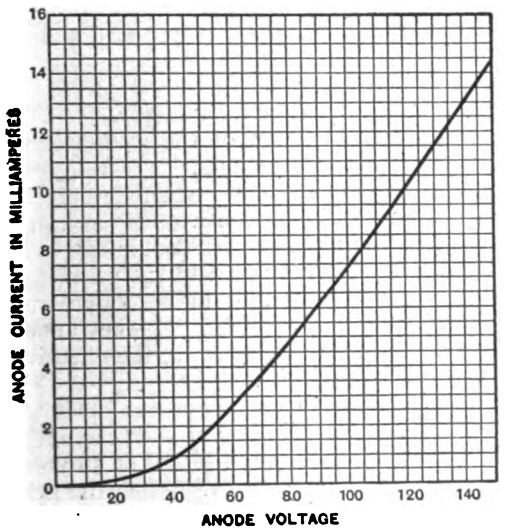

Fig. 2. The curve shows the relationship of anode current to anode volts with a fixed grid potential.

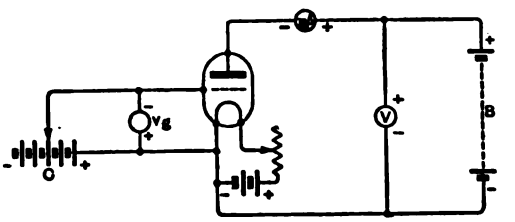

Fig. 3. Connections of the valve for finding the grid volts-anode current characteristic.

milliammeter. The milliammeter may be one reading 0-15 milliamperes, and the voltmeter across the anode battery, 0-150 volts. Connect the grid to the negative side of the filament.

With the filament heated to its normal temperature, take readings of anode current for various anode voltages. Make a note of the anode current at 10, 20, 30—up to say 150 volts. Then plot the values on squared paper, and so obtain a curve such as that of Fig. 2. This curve then shows us how the anode current varies when the anode voltage is changed, the grid being connected to the negative side of the filament.

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To secure the information for the second curve, connect the valve as shown in Fig. 3. A high tension battery B, of say 100 volts, as measured by the voltmeter V, is connected with a milliammeter mA in the anode circuit. In the grid circuit connect a low-reading voltmeter Vg and a battery of single cells C, in order that the grid may be given as negative a voltage as desired. With the filament heated to normal, and the anode voltage fixed, make a note of the anode current for various grid voltages, and plot a curve such as that of Fig. 4.

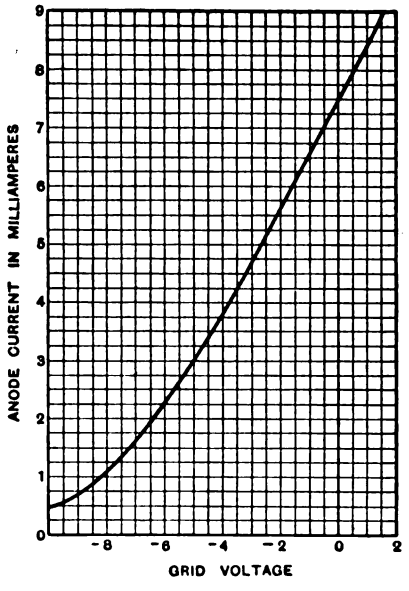

Fig. 4. Curve showing the relationship of anode current to grid volts with a fixed anode voltage.

The Effect of Grid Bias.

Let us now examine these two curves. We notice at once that the anode current, with zero grid volts, Fig. 4, has the same value (7·4 mA) as when the anode voltage, Fig. 2, is 100. This is easily understood, because of the points considered; the anode voltage is 100 and the grid voltage zero in both instances.

However, to prevent grid current distortion, it is usual to give the grids of valves employed in low frequency amplifiers a negative voltage. Suppose then that the grid is given a negative bias of 1·5 volts. What effect has this on the anode current? Referring to Fig. 4, we see that when the grid is 1·5 volts negative, the anode current is 6·1 mA. The anode current is reduced by making the grid more negative. When the anode current of Fig. 2 is 6·1 mA, however, the anode voltage is only 90. The effect of making the grid 1·5 volts negative, therefore, is to reduce the anode current to a value which it would have if the grid voltage were zero and the anode voltage reduced from 100 to 90. In other words, the voltage on the grid has seven times as much effect on the plate current as a similar change in anode volts. The amplification factor of the valve is therefore 7.

But this is not the point which we wish to emphasise here. The important point is that from the curves of Figs. 2 and 4 we can see that a given anode current can be set up by a combination of grid and anode voltages. Thus, 100 volts on the anode and -2 grid volts gives an anode current of 5·6 mA (Fig. 4); Fig. 2 shows that this anode current may be obtained by connecting 86 volts to the anode and the grid to the filament.

If the grid bias is $-$ 6 volts, the anode current is 2·25 mA, which is equivalent to connecting 58 volts to the anode and the grid to the filament.

The effect then of making the grid more negative is to reduce the anode current as though the anode voltage was reduced by an amount depending on the amplification factor of the valve multiplied by the grid voltage. This may be expressed as follows:—

The anode current, I_A, is proportional to
$K\ (E_A + ME_G + e)$, where
E_A is the anode voltage
M is the amplification factor
E_G is the voltage of the grid battery
K and e are constants.

The effective voltage causing anode current is the sum of the anode voltage and the product of the amplification factor and grid voltage. A voltage applied to the grid (E_G) affects the anode current in the same way as a voltage ME_G added to the anode voltage. Put in a simpler way, the effective voltage $= E_A + ME_G$.

Thus referring to the above examples we see that when the grid bias is $-$ 6, the effective anode voltage is $100-(6\times7)$ or 58 volts and the current is 2·25 mA. When the grid is 2 volts negative, the effective anode voltage is $100-(2\times7)$ or 86 volts, and the anode current 5·6 mA.

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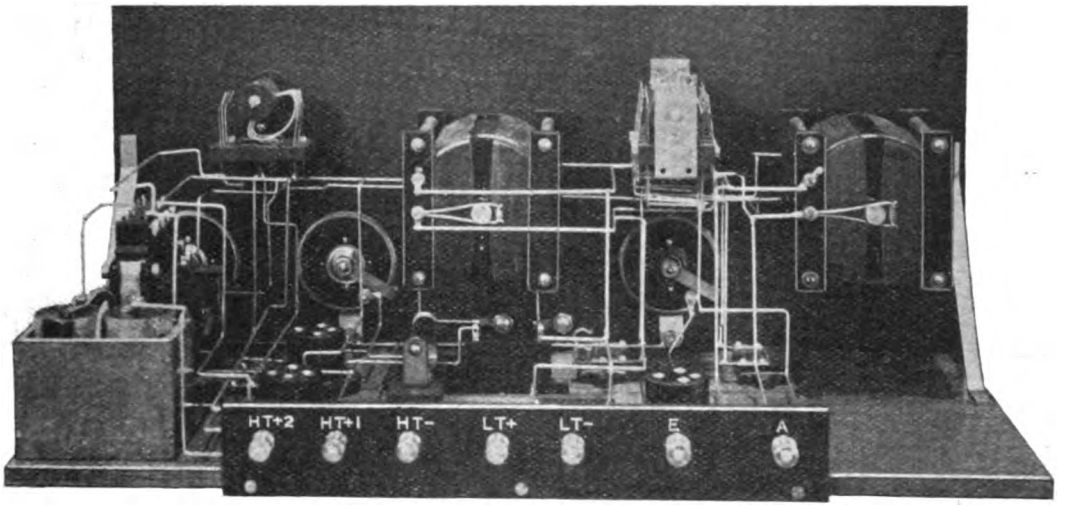

A back view of the assembled receiver.

A TWO-KNOB THREE VALVE RECEIVER.

TUNING FROM 250—2,800 METRES.

This concluding instalment gives the details for wiring and completing the assembly of the receiver dealt with in the last issue. Particulars for the construction of the cabinet are also given.

By HUGH S. POCOCK.

(Concluded from page 376 of previous issue.)

THE first step in the assembling of the set should be to obtain the wooden baseboard and the panel. Unless the panel is purchased ready prepared and squared up, this must be done first, but it is much better to buy the panel ready for use squared up and rubbed down. Radion panels are so prepared to the dimensions advertised. After the necessary holes have been drilled in the panel in accordance with the diagram, Fig. 5, given in the last issue, the panel should next be attached to the baseboard. This is done by means of screws through the bottom edge of the panel, and the fixing is strengthened and held rigid by means of two brass brackets. These may either be bought ready or may be made from strip brass. The fixing screw holes for the brackets should not be drilled in the panel until the brackets are ready. If they are made up by the constructor great care must be taken in bending the brass to the required angle. It cannot, of course, be bent sharply, or it will crack. The strip should be held in a vice at the point where it is desired to bend it, and should be gently and gradually bent over by tapping with a hammer. Having made or obtained the brackets the position on the panel for the fixing screws should be marked and the holes drilled in case they differ from the positions given in the diagram.

Next the wiring to the Utility switch, which switches the L.F. valve, may be treated in the same way as the barrel switch, making as many as possible of the connections before the switch is fixed to the panel. For this it will be necessary to follow the wiring diagram Fig. 7, and after this has been done attention can be directed to the variometers. It will be observed that two connections

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have to be made at each end of the variometers, and therefore two of these on each instrument are fixed between the variometer and the panel. To put these connections on neatly it is again almost imperative to solder them before the variometer is fixed in place on the panel, so that again those wires must be carefully measured to the next points of attachment and bent to the correct direction.

All wires, which should be No. 16 tinned bare copper, should be stretched in convenient lengths, and the bends should, for the sake of appearance of the finished set, be made at right angles as far as possible, but I do not suggest that all wiring used be so arranged if convenience or the possibility of using shorter leads may dictate otherwise.

Fig. 8 gives the dimensions and drilling

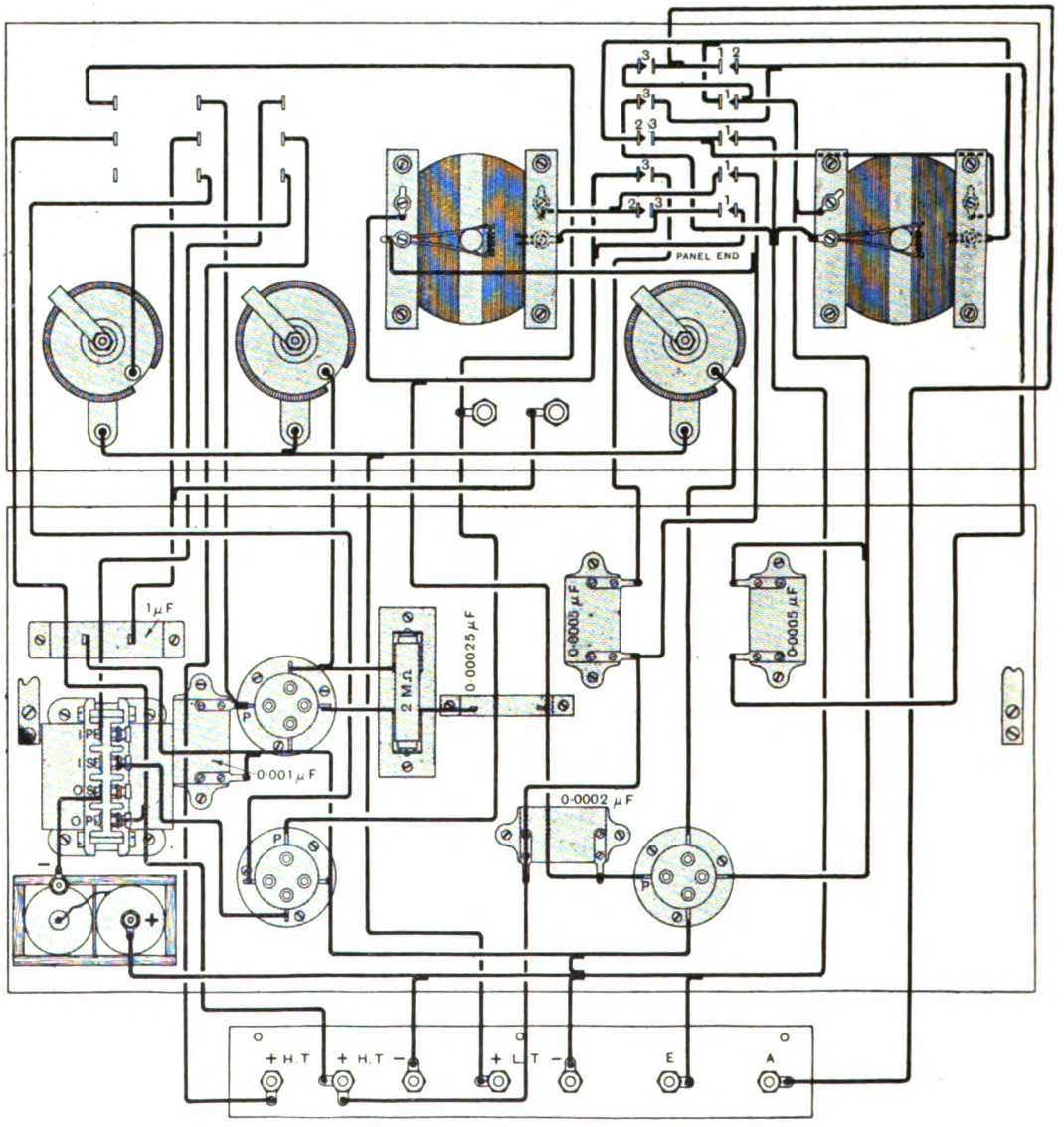

Fig. 7. Complete wiring diagram.

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sizes for the terminal strip, which is screwed in place at the back edge of the wooden base so that when the box is constructed, the ebonite is flush with the back of the box, leaving the terminals projecting. It will be seen that two H.T. positive terminals are provided, so that additional potential can be applied to the plate of the L.F. valve.

The wiring to be done after the components are assembled on the panel and baseboard is comparatively simple, and by following the diagram Fig. 7, no difficulties are likely to be met with. It will be observed that two cells are used to provide a negative potential to the grid of the L.F. valve, and this valve may be a B.T.H., B 4, or an L.S.2, or a valve of similar type. The R 5 v type valves may conveniently be used with these for H.F. and detector stages, when a six-volt battery will be required for filament heating.

No stipulations are made as to the wood used for this cabinet as this is left to individual discretion. If a very good-looking set is required, the wood can be mahogany and polished, or it can be plain white wood, stained after the box is completed, if its purpose is simply to keep the set free from dust and to protect it from damage.

When the receiver has been completely finished, it should be tried out for any possible faults which may occur, perhaps not so much through accidents in wiring as through failure by one of the switches to make a good contact. The barrel switch should be checked over carefully to see that proper contact is being made at all the points where the blades should come together in the three positions. It will very likely be found that in the process of fitting to the panel and soldering the connections

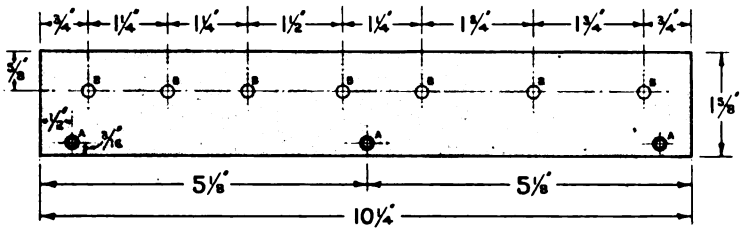

Fig. 8. Details for the terminal strip; A, drill ⅛" dia. countersunk for No. 4 wood screws; B, drill 7/32" dia.

All the information necessary for the construction of the set should now be at the disposal of the reader, and therefore we can pass on to some notes on the operation of the receiver and instructions for making a cabinet for housing the set if this is required.

The dimensions and other details of the box to contain the receiver are given in the illustration, Fig. 9, and the photograph of the complete set (see page 372 of previous issue) shows the appearance when the receiver is completed. It is necessary that the lid of the box should be hinged as shown, in order to facilitate the interchange of valves or to get at any connections easily if necessary. By adopting the method of construction indicated, it will be seen that the receiver itself is independent of the box and is self-contained, so that by simply sliding out the ebonite panel, the complete receiver is removed with it, leaving the empty box, as shown in Fig. 9.

that a blade may become slightly bent, so that when the under blade is pressed towards it, it just fails to make contact. A very slight bending inwards of the outer blade from close to its base will make the necessary correction and it must be noted that this bending will have to be very slight, otherwise the two blades make permanent contact and do not separate where they should. After the present set was assembled, two of the blades were found to require adjustment in this way, and the failure to make contact was a fault at first rather difficult to trace. The set shown in the photograph does not indicate any engraving on the front panel, but if it is desired, this can be done by sending away the panel after drilling with the positions and lettering for engraving marked. With the arrangements of the leads of this set it is possible to remove the panel from the set even after the wiring has been done without interfering

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greatly with the connections, and no soldered joints need be undone, as the only points where leads actually go to components on the panel are where terminal tags can be employed.

In trying out the receiver it will be found that the tuning is distinctly sharp and the settings of the two dials run approximately together so that when once the scale settings of the anode variometer have been ascertained for various stations on the three ranges, there should be no difficulty in picking up these stations as required, because the setting of the aerial variometer will be within a few degrees of the same reading as the anode variometer.

with longer wavelength range, it is nevertheless possible in practice to get sufficient reaction to receive continuous wave stations and to stimulate amplification by the inclusion of a fixed condenser between the anode and grid leads of the first valve. As I have mentioned already, the necessity for this capacity coupling to produce reaction effects will depend on the arrangement of the wiring to a certain extent and therefore it is well to have some means of introducing this capacity which can be conveniently increased until the requisite value is obtained. The simplest method of doing this is to take two pieces of well insulated copper wire about 4 ins. long and solder

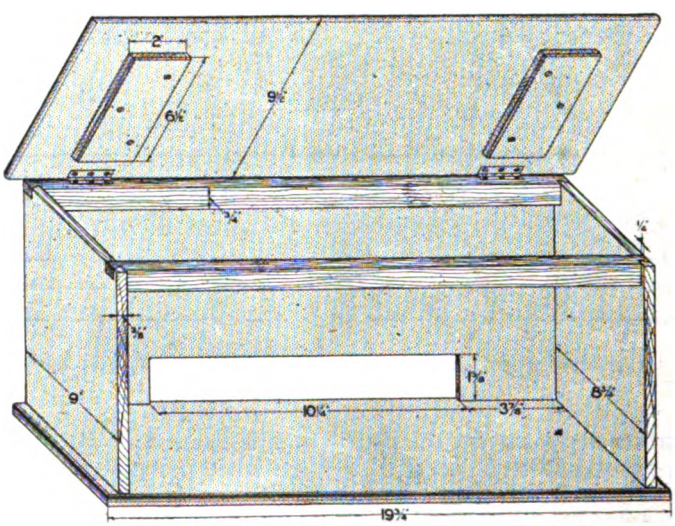

Fig. 9. Dimensions for building the cabinet.

It will probably be found when testing out the set, that whilst spark and telephony stations come in well, the set does not quite oscillate even when the two variometers are in tune. Whether it will oscillate slightly or not depends largely on how the individual constructor has arranged the wiring and this is why it has been left until now to make the final adjustment which will give comparatively uniform oscillation if required over the wavelength range. Although the tendency to oscillate will naturally decrease

one each to the leads coming from the plate and grid of the valve holder of the first valve. Then take the two leads and twist them together, when the capacity between the leads will provide the condenser required. The ends will, of course, be left free and the two leads will be wound up until it is found by experiment that the set oscillates sufficiently to receive C.W. stations on all three ranges. Once found, no further alteration need be made and this condenser value can be left permanently.

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WAVEMETERS

By L. B. TURNER, M.A., M.I.E.E.

(*Continued from page* 386 *of previous issue.*)

(5) WAVELENGTH STANDARDS.

WE have seen in the last section that the triode oscillator offers facilities which render it an indispensable instrument for wavelength measurements. Is it, then, feasible to construct triode oscillators accurately calibrated for wavelength so that they can be kept as standards? As far as ordinary convenient practice is concerned, I think the answer can only be no. The calibration is so liable to be upset by replacement of the triode, or change of battery voltage, that it is most undesirable to rely on such an oscillator as an accurate standard. The proper course is to provide a series of wavelength standards from which the oscillator can be checked or connected at any time when it is required for use as an accurate wavemeter. We have seen that, thanks to the available harmonics, the standards need not cover a wide range.

The most obvious form of such a standard is a robust invariable inductance coil of low resistance joined by leads of constant or negligible inductance and capacity to an invariable condenser. The latter is preferably a good mica condenser, sealed solid into a box with wax; and, where the wavelength is very short, it is a good plan to seal the whole—condenser, coil and connections—in a block of wax. Constancy is then assured, even if the instrument is subject to the ravages of the inquisitive fiend with a screwdriver. An example of this construction is shown in Fig. 10. Two wavelengths, nominally 50 and 45 metres, were by this instrument fixed for the factory adjustment of the circuits of a fixed-tune portable military telephone outfit. At that time the official standard wavemeter was undergoing corrections, at these short waves, about once a week, and it was necessary to take a firm line and say that, as far as the British Army and this telephone set are concerned, this is "50 metres" and ever more shall be so.

It is clearly best in principle that the standard $L\,C$ circuit should have no exciting or detecting apparatus attached to it. In the example shown a crystal detector was provided as part of the standard, but care was taken to employ such a large C and a small L that the detector could produce no appreciable effect on the wavelength.

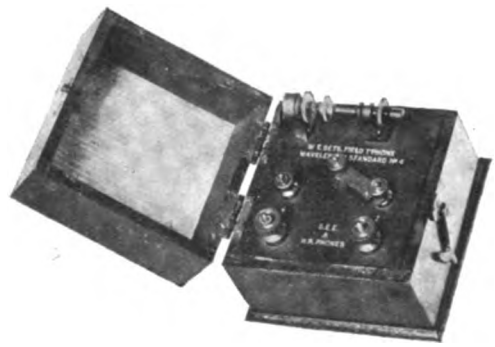

Fig. 10.

Superior to a crystal detector with telephone or galvanometer is that beneficent instrument, a Moullin H.F. voltmeter*; but by using the well-known click phenomenon, resonance between oscillator and standard may be observed by a telephone connected to the oscillator without any conductive connection to the standard at all.

(6) POINTS IN THE DESIGN OF AN EVERY-DAY WAVEMETER.

For many purposes a simple wavemeter, with a crystal detector for use with telephone or galvanometer when receiving, and with buzzer excitation for transmitting, is a great convenience. It may not be very precise, but it can be constant; it has no harmonics (which are a nuisance once calibration is

* *Journal I.E.E.*, February, 1923.

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done), and it uses no H.T. or filament battery.

Apart from obviously necessary qualities in a measuring instrument, such as mechanical soundness in the moving parts (condenser or coil), a satisfactory design may take various shapes, provided always that the following conditions are met:

(*a*) The buzzer must not be unsteady, for this drives the user mad.

(*b*) The buzzer must not show any trace of spark at the contact, for this leads to (*a*), and spoils the H.F. oscillation.

(*c*) The buzzer current must not pass through the coupling coil, for this shocks the circuit under test into its own natural oscillation, whatever the wavemeter setting.

(*d*) The coupling must not change with change of wavelength setting, for we wish to impress or receive an e.m.f. constant in magnitude while variable in frequency.

(*e*) The calibration must not be subject to upset from capacity effects from the hands, or from adjustments of the crystal detector.

(*f*) There should be good overlap between successive ranges.

(*g*) The decrements should be fairly low at all wavelengths.

(*h*) A sensitive indicator (telephone) should be provided for, even if other indicators, such as the ingenious Townsend lamp, are also available.

(*i*) Preferably, the buzzer should be accessible, and not very noisy, and its battery should be easily replaced.

Most of these conditions, and the manners of meeting them, will be fairly obvious to you, but I may enlarge a little on two of them. I assume that the buzzer is used in the usual way after the manner of Fig. 11. The buzzer opens when a current I is flowing in L; and if the break is sudden and complete an oscillation of initial energy $\frac{1}{2} LI^2$ is set up in $L\,C$. The buzzer magnet must obviously be adequately shunted with resistance or condenser S to delay the fall of magnet current when the break occurs; and clearly the smaller the part of I which flows round the magnet, and the larger the part in S, the better.

But control of the P.D. across the magnet winding is not sufficient to prevent sparking. Even when, as in Fig. 11, the buzzer inductance is completely shunted by the condenser, the quantity $I\sqrt{\frac{L}{C}}$ must not be too great; otherwise sparking is bound to occur. In wavemeters where a single variable condenser C is used with several values of L for the several ranges, this trouble is often met at the longer waves. This is one point in favour of variable L and fixed C.

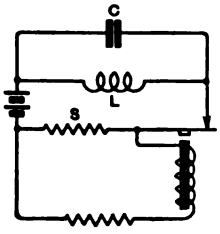

Fig. 11.

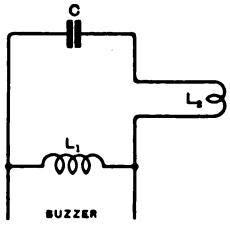

Fig. 12.

In Fig. 11 condition (*c*) is violated, for coupling can be made only to the coil carrying the buzzer current. If, however, we change to Fig. 12, sparkless working becomes an impossibility. Sudden buzzer break would require sudden growth of current in L_2, and an indefinitely large P.D. would be produced across L_1. There are two alternatives, shown in Figs. 13 and 14. Each of these is theoretically sound; but

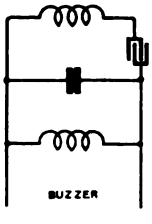

Fig. 13.

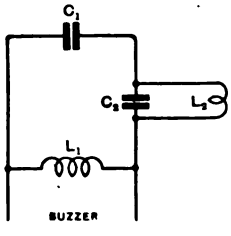

Fig. 14.

Fig. 13 is inconvenient if a fixed condenser is used, and in Fig. 14 two frequencies occur. Provided, however, that $C_2L_2 << C_1(L_1 + L_2)$ the oscillation of the higher frequency will be so much higher and so feeble as to be inappreciable. Such considerations are no merely academic question, as is shown by the fact that visible sparking may be observed when a buzzer breaks a current of 0·2 ampere or so through an

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unshunted inductance of only some 20 microhenries. And as long as the buzzer contacts remain bridged by the arc, any oscillation in the $L\,C$ circuit is desperately damped by the resistance shunt thereby provided across L.

Fig. 14 is an attractive arrangement, with C_1 a series of fixed mica condensers, L_1 a variable inductance of the variometer type, range. Hence if $\mathcal{I}$ is the initial value of the oscillatory current, and if we neglect the change of resistance as L_1 is varied in tuning,

$$\mathcal{I} \propto \sqrt{L_1}$$

$$\propto \frac{1}{n} \text{ if } L_2 << L_1$$

Hence the e.m.f. impressed in the circuit

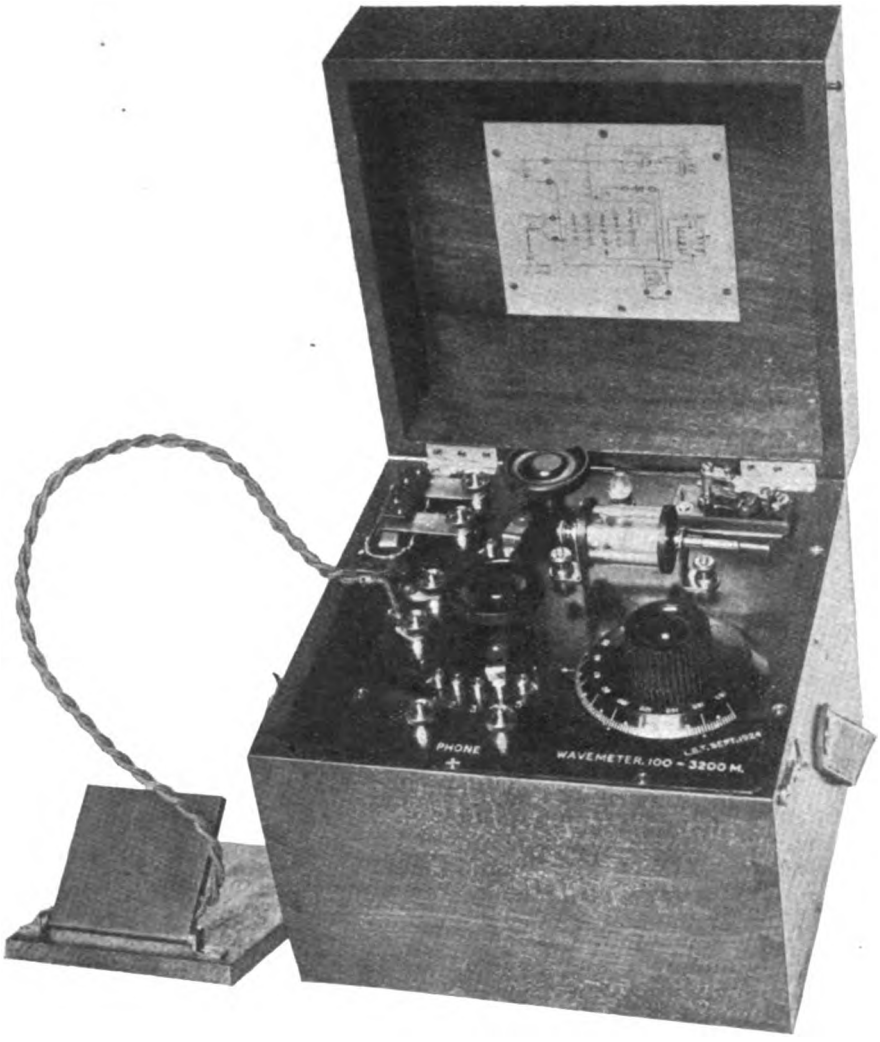

Fig. 15.

L_2 a small movable coupling coil, and C_2 a small capacity, such as that between the conductors of a short piece of flexible cord leading to L_2. The buzzer excites the same coil, with energy $\frac{1}{2} L_1 I^2$ per break, on every under test coupled with L_2, being proportional to $n\,I$, is constant as L_1 is varied. This is the correct condition for detecting resonance by the occurrence of maximum current; it does not obtain in wavemeters where L is

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fixed and *C* varied—an error which, however, becomes serious only if the decrement is high.

I have here (Fig. 15) a wavemeter constructed on these lines. I do not proffer it as an instrument of any outstanding virtue, but as an example to stimulate discussion and criticism. It has five ranges covering wavelengths of 100—3,200 metres, and its electrical dimensions are given in Fig. 16 and Table 3. For reception a carborundum rectifier is fitted. This does not appreciably increase the decrement of the circuit; although when silicon was used the decrement was greatly increased. For sending there is a buzzer, whose shunt is a small lamp. The two coils of the variable inductance—an "Igranic" variometer—are connected in parallel; and, being wound in opposite directions, give a minimum self-capacity at the position of minimum inductance. The wavelength-degree curves with this ball-form of variometer are fairly straight over the whole scale. The measurements quoted in Table 3 have been made at 20 degs., 90 degs. and 160 degs. on the scale.

TABLE 3.

	Range.				
	1	2	3	4	5
λ at 20° ..	102	185	363	725	1,470
λ at 160° ..	257	455	900	1,720	3,550
Receiving decrement at 20°	·08	·08	·09	·07	·11
Receiving decrement at 160°	·03	·05	·04	·035	[·05 at 90°]
Sending decrement at 90°	·6	·34	·15	·12	·09

I am particularly interested in—and, I may add, disappointed by—the sending decrements. I have not seen other measurements of the decrements of buzzer-excited oscillations, and should be glad to hear of any in the discussion. The rise of decrement due to the buzzer is very marked at the shorter waves. I do not think it is due to sparking at the buzzer contact; firstly because none is visible; and secondly because, in a test on range 2, replacement of the 10 Ω lamp shunt across the buzzer magnet by a 40 Ω shunt made no perceptible change in the decrement. I think the rise must indicate that there is an appreciable epoch of poor conductance across the junction after mechanical separation has begun, but is incomplete. We must bear in mind that with short waves the oscillation is all over in an extremely short time—say in about 4 micro-seconds in Range 1 and 500 micro-seconds in Range 5. Any, even very brief, transition epoch of poor conductance intervening between sensibly perfect short circuit and complete break is therefore to be feared.

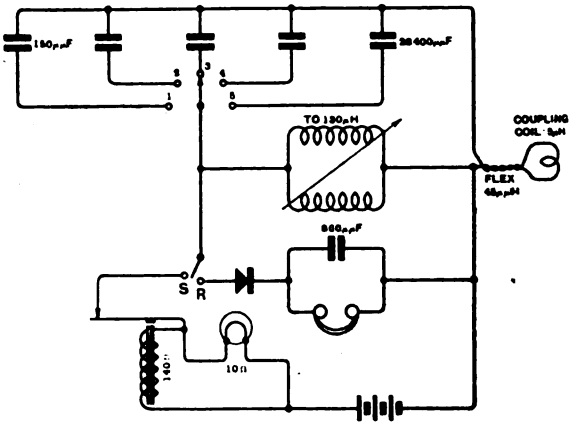

Fig. 16.

In conclusion, I feel that a word almost of apology is called for. I have been wearying you with talk which, you may have felt, would have suited your grandfathers—talk of buzzers and crystals. In my own mind recollections have been awakened of the time when the buzzer was a necessary and exasperating instrument for laboratory measurements; recollections

"Of old unhappy far-off things,
And battles long ago,"

which I had supposed abolished from my life by the happy triode of to-day. But I do think that in the domestic wavemeter there is still a field for the buzzer and the crystal; and I thank you for patiently hearing me speak of them at the end of a rather lengthy paper.

(The ensuing discussion will be included in a subsequent issue.)

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PATENTS AND ABSTRACTS

A Method of Winding Multi-Layer Coils.

The method of winding a multi-layer tuning coil described in Patent No. 216,084 may be gathered from Fig. 1.

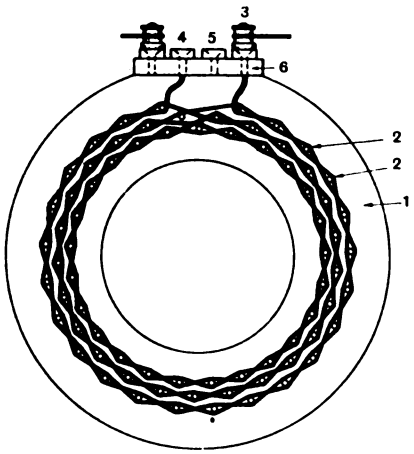


Fig. 1. A multi-layer coil.

A former consisting of a disc of wood (1) has an odd number of pins (2) arranged on its surface, the pins in one row being opposite the spaces of the pins in the next row. The number of pins, their length, and the distances between them will vary according to the thickness of the layers to be wound.

In forming a flat coil, the first layer of wire starts from one terminal (3), and is laid round in a zig-zag path between the pegs, and terminates at contact 4. A second layer may start from contact 5, following the path of the first layer, and ending at another contact, mounted on a strip of insulating material (6). A number of layers, according to the number of rows of pegs employed, may be wound. When the winding is completed, the pegs may be withdrawn.

To support the winding a disc of insulating material, such as treated cardboard, may be placed on each side of the coil, and the winding secured to the discs by thread.

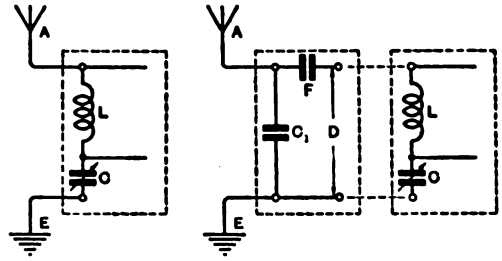
Various combinations of the coils may be employed, and it is not necessary that the wire of the coil be laid regularly along the pegs in the manner illustrated in the figure.

A Filter Circuit.

When interference due to atmospherics, spark signals, etc., is experienced, considerable relief may usually be obtained by connecting a suitably arranged filter circuit (or "wave-trap") in the aerial or other tuned circuit.

The filter circuit usually comprises a condenser and inductance, the condenser generally being of the adjustable type. Patent No. 217,601 discloses a simple scheme for reducing interference, which consists in connecting between the aerial and earth an arrangement of condensers.

The connections of Fig. 2 are those of an ordinary receiver, having an aerial A, tuning coil L, condenser C, and earth E.



Figs. 2 and 3. Showing a simple filter circuit connected to a receiver.

Fig. 3 shows the invention. Between the aerial and earth a condenser C_1 is connected, which preferably has a capacity of two or more times that of the aerial, and a condenser F is connected in one of the wires, D, connected to the receiver.

The condensers may, of course, be built in the receiver, or form a separate attachment.

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Bradford Corporation proposes to issue licences for wireless aerials across streets at a charge of 2s. 6d. each.

* * * *

Arguing that wireless listeners have not contributed their financial share to the support of the game, Mr. Tex Rickard has decided to forbid the broadcasting of boxing matches promoted by him.

* * * *

A radio society has, we understand, been formed at Southall, Middlesex.

* * * *

A microphone has been installed on the White Star liner "Cedric" for broadcasting the ship's orchestral concerts to the third-class quarters.

* * * *

A report of a banquet to Mr. Owen Young in New York on December 11th, was published in the *Johannesburg Star* on the following day. The speeches were broadcast and picked up in Johannesburg.

* * * *

GOOD WORK WITH A T.V.T. UNIT.

Mr. D. B. Knock **(6 XG)** reports that, using an ex-Government T.V.T. unit for H.T. supply with a Phillips 5-watt valve, he is able to maintain reliable communication over a distance of 1,000 kilometres. Among the stations recently worked under the above conditions are Finnish **3 NB** (at 7.30 a.m., in daylight); Italian **1 ETR**, owned by Countess Elena Thaon di Revel Florence, and at the time of communication operated by Signor Giulio Salom; also Danish **7 ZM**, and Swedish **SMZV** and **SMZN**. In each case **6 XG's** signal strength was given as comfortably readable. Mr. Knock would be glad to know whether any other readers have effected greater distances with a T.V.T. unit.

CHRISTIANIA EXPERIMENTAL BROADCASTING STATION.

The installation of a temporary broadcasting station at Christiania is reported to us by an English reader in Norway. The power of the station is understood to be at present ½ kW., and the wavelength varies between 440 and 500 metres. Experimental transmissions take place daily from 7.30 until about 10 p.m. (G.M.T.).

From the same source we learn that a Norwegian broadcasting company is in course of formation, modelled on the lines of the B.B.C., but with a maximum capital of 350,000 kroner. As soon as arrangements are complete, a Marconi "Q" transmitter will be erected in Christiania.

RADIO AND U.S. BUDGET ALLOWANCE.

An idea of the growth of wireless activity in the United States can be gained from the general belief that Secretary Hoover, in presenting next year's Budget before Congress, will ask for a larger appropriation for the Radio Section of the Department of Commerce. The prospective allowance of 215,238 dollars, which is an increase of 10,000 dollars over the present year, is deemed insufficient for the work of the Section.

TETRAZZINI'S CHRISTMAS PROGRAMME.

The Italian agent of Burndept, Ltd., calls attention to a very interesting programme which will be broadcast from the Rome station on Christmas Day.

Madame Luisa Tetrazzini, the famous prima donna, assisted by Signor Ugo Donarelli, will sing the Mad Scene, from "Othello" (Verdi), and "La Ci Darem La Mano," from "Don Giovanni" (Mozart).

For the benefit of British listeners, Madame Tetrazzini will sing certain items in English, including "The Last Rose of Summer" and "Somewhere a Voice is Calling."

Owners of efficient receivers should certainly try to pick up this concert, which will commence at 8.30 p.m. (G.M.T.). The wavelength of the station is 425 metres.

NEW ZEALAND BROADCASTING.

An unfortunate occurrence marred the inaugura transmission from the new broadcasting station at Wellington, N.Z., at the end of October, writes Mr. H. Ninnis. A locally constructed transmitter was used, with a power of 500 watts, and after broadcasting had been carried on for ten minutes the filter circuit blew out, putting an end to the performance for that day.

The present transmissions are stated to be good, but it is felt that improvements would be effected with the use of a more suitable microphone.

The amateur regulations at present in force in New Zealand forbid the use of reaction on the aerial circuit, but in spite of this, "howling" is very prevalent and the broadcast programmes are considerably interfered with.

AERIALS AND BIRD CASUALTIES.

Pigeon societies and organisations for the preservation of bird life have made an appeal to the Postmaster-General for legislation to enforce the use

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of corks on aerials. It is stated that, despite their keenness of vision, birds frequently cannot see the wires until too late, and are either killed or badly injured. A naturalist expresses the opinion that a cork placed every two yards along an aerial is quite sufficient.

It is unlikely that legislation of this kind would be introduced by the Post Office in the immediate future, in view of the fact that the same reproach can be levelled at that department in respect of open telegraph wires. As these wires, besides being more plentiful than aerials, are stretched to a far greater tautness, their toll of bird life must be correspondingly heavier.

TELEPHONY TESTS FROM ss. "LEVIATHAN."

Apropos of the note in our issue of December 3rd regarding Mr. E. A. Richardson's reception of telephony from ss. "Leviathan," Mr. F. H. Lindsay, of Belfast, suggests that the vessel was not at the time in the neighbourhood of Cuba as stated. The "Leviathan" left Southampton for New York on November 25th (five days later), and could not possibly have come from the Gulf of Mexico in that time.

Mr. Lindsay states that he picked up telephony from the vessel at 12.30 a.m. on November 26th, when her position was given as 750 miles off Cherbourg, westward bound.

Letters of corroboration have also reached us from Mr. S. T. Clark, of West Hartlepool, and Captain Fletcher, of Godalming.

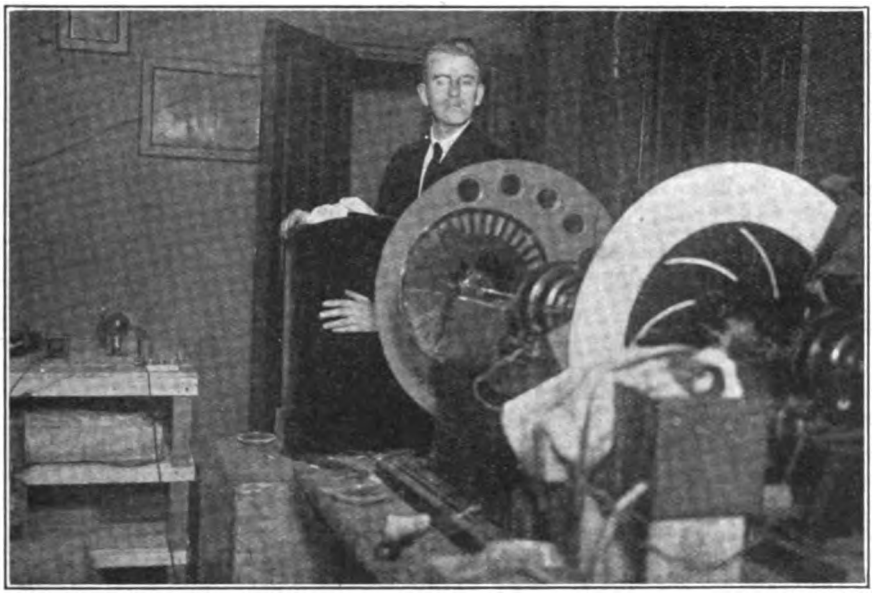
DENMARK-AMERICA TWO-WAY COMMUNICATION.

The American Radio Relay League reports that a Danish amateur was recently worked by Mr. D. C. S. Comstock, of East Hartford. The Danish transmitter sent the following message: "Greetings from the first Danish amateur across." Mr. Hiram Percy Maxim, President of the A.R.R.L., replied, through Mr. Comstock, "Sincere congratulations. Hope that we communicate often."

BURNDEPT CHAIRMAN'S GIFT.

Readers may be interested to learn that Mr. Geoffrey E. Duveen, whose gift of £50,000 to the University College Hospital recently roused considerable public attention, is the chairman, and one of the founders, of Messrs. Burndept, Ltd., the well-known wireless firm.

This munificent gift is for the purpose of rebuilding the Ear Hospital, a scheme which the donor is carrying out in memory of his father, the late Mr. Henry J. Duveen.



Mr. J. L. Baird, the inventor of a very promising system of television, photographed with his apparatus. An earlier form of the device was described in "The Wireless World and Radio Review" of May 7th, 1924.

ANNUAL EXHIBITION OF PHYSICAL AND OPTICAL SOCIETIES.

The Annual Exhibition of the Physical Society of London and the Optical Society, which is to be held on Wednesday and Thursday, January 7th and 8th, 1925, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, will be open in the afternoon (from 3 to 6 p.m.) and in the evening (from 7 to 10 p.m.).

Among the lecturers will be Mr. C. F. Elwell, B.A., M.I.E.E., who will give a lecture, with demonstration, on "Talking Motion Pictures," at 8 p.m. on January 7th, and at 4 p.m. on January 8th. More than 50 firms are exhibiting scientific apparatus, and a number of experimental demonstrations have been arranged.

We understand that invitations have been given to the Institution of Electrical Engineers, the

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Institution of Mechanical Engineers, the Chemical Society, the Radio Society of Great Britain, the Rontgen Society and the Faraday Society.

Admission in all cases will be by ticket only, and members of the societies mentioned should apply to the Secretary of the Society to which they belong. Others interested should apply direct to Prof. A. O. Rankine, Hon. Secretary of the Physical Society, Imperial College of Science and Technology, South Kensington, S.W.7.

AMERICAN RECEPTION AT 8 p.m.

An interesting experience of the evening reception of what was probably an American amateur is reported by Mr. N. A. Champness, of Acton, London. On December 6th, at 8 o'clock (G.M.T.), on the evening in question, our correspondent heard the call "**2 GF u 1 ANA,**" on a wave-length between 50-55 metres. If this transmission is confirmed a new record seems to have been established for early evening transatlantic work A single-valve receiver was used.

A GRATIFYING REPORT.

Remarkable reception of his signals by a German amateur is reported by Mr. Leonard H. Crowther **(G 2 LH),** of Sheffield. According to the French *Journal des* 8, signals from **2 LH** were heard by an amateur in Charlottenburg, Germany, with an indoor aerial 4 metres long, and a two-valve receiver (o-v-1). At the time of the transmission in question **2 LH's** input was approximately 8 watts, with an aerial ammeter reading of 0·18 amperes.

A WIRELESS COMPETITION.

A competition open to amateur constructors has been organised in aid of Chesterfield local charities by Messrs. The Creswick Dixon Electric Co., of Bodega Chambers, High Street, Sheffield. Prizes to the value of £37 10s. are being offered for the best amateur construction of four, three, two and single-valve sets. The competition closes on January 31st, 1925. Particulars regarding entrance fees can be obtained on application to the company.

CZECHO-SLOVAKIAN AMATEUR ACTIVITY.

The last few months have seen great advances in the progress of radio in Czecho Slovakia. A powerful commercial station has been established at Podebrady, estimated to have an effective range of over two thousand miles. Two slightly less powerful stations have been erected at Bratislava and Kosire respectively.

The Government has adopted an encouraging attitude towards the wireless amateur and large numbers of radio clubs have recently been formed. The retail sales of experimental wireless equipment and broadcast receivers are stated to be mounting rapidly.

Coincident with the holding of a special radio exhibition at Prague from March 22nd to 29th 1925, an amateurs' conference will be held in the city, and it is hoped that many Americans who will be attending the amateur conference in Paris will also attend the Prague event.

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2 XM.

Mr. W. S. Ritchie, Hon. Secretary of the Downside School Wireless Society, Stratton-on-the-Fosse, near Bath, advises us that the call sign **2 JB** no longer belongs to the Society's station. The present call signs are **2 XM**, **2 XN**, and reports of reception are always welcome.

Calls Heard

Newcastle-on-Tyne (all Morse, below 150 metres).
French: **8 AG, 8 AQ, 8 AT, 8 AU, 8 BF, 8 BU, 8 CH, 8 FI, 8 GI, 8 GN, 8 GO, 8 GVV, 8 JB, 8 PA, 8 PB, 8 RG, 8 RV, 8 SS, 8 SSC, 8 VV, 8 XH, 8 XR, 8 ÉM, 8 ÉJ.** Belgian: **4 AA, 4 AL, 4 QS, 4 C2.** Dutch: **0 GC, 0 MI, 0 OX, 0 RE.** Danish: **7 CM, 7 EC, 7 ZM.** American: **1 JXH, 5 MET, 6 OL.** Swiss: **9 AA, 9 BR.** Miscellaneous: **P 2 JF, 3 EAR, FN 2 NM, 2 RRI**(?). (o—v—o)
F. Thompson (**2 AWK**).

Acton, W.3 (November 1st to 10th, on 66 to 95 metres).
Weak British: **2 CG, 2 MU, 5 RM, 5 RZ, 5 UQ, 6 FG, 6 MR.** French: **8 AB, 8 AL, 8 AQ, 8 AU, 8 AZ, 8 CM, 8 CN, 8 CS, 8 DP, 8 ÉM, 8 ÉN, 8 ÉQ, 8 FQ, 8 GH, 8 GO, 8 GP, 8 HSM, 8 JBL, 8 MAR, 8 PA, 8 QG, 8 RBR, 8 SSU, 8 UU, 8 VR, 8 ZH, 8 ZZ.** Dutch: **0 BQ, 0 KC, 0 RD, 0 RE, 2 NCA.** Danish: **7 BD, 7 WM.** Belgian: **B 7, W 2.** Swedish: **SMZV, SMZY.** Finnish: **3 CA, 3 CC, 3 CM, 3 MB, 3 SS, 3 ZS, 10 KZ.** Swiss: **9 AD.** Italian: **1 ER, 1 FP.** Luxembourg: **0 AA, 1 JW.** Canadian: **1 AR, 1 DM.** American: **1 AAU, 1 AJA, 1 AUR, 1 AW, 1 AWW, 1 BDH, 1 BGQ, 1 BIP,**

Drawn by the Canadian amateur, **1 DD,** *this cartoon symbolises American astonishment at the irrepressible efforts of the British and New Zealand transmitters.*

1 BKQ, 1 BQK, 1 BVS, 1 BY, 1 CCX, 1 CKP, 1 CLN, 1 CMP, 1 CRU, 1 GV, 1 IL, 1 KC, 1 ML, 1 OW, 1 PJP, 1 SF, 1 SW, 1 XAV, 1 XW, 1 XZ, 2 AAY, 2 ANA, 2 BQW, 2 BOU, 2 BRR, 2 CEI, 2 CHK, 2 CLA, 2 CVS, 2 CVU, 2 CYW, 2 KUE, 2 PD, 3 BCO, 3 BDO, 3 BG, 3 BP, 3 CHC, 3 COJ, 3 DK, 3 FZ, 3 JR, 3 JW, 3 TJ, 3 WB, 3 ZW, 4 EZ, 4 KU, 4 MAF, 4 XE, 5 AL, 5 CN, 5 OX, 5 WZ, 6 HL, 8 CCQ, 8 CKO, 8 PL, 8 UVL, 8 ZG, 9 BHX. New Zealand: **4 AA, 4 AK.** (o—v—1.)
N. A. Champness.

Nottingham (November 16th to November 23rd).
British: **2 DX, 2 FN, 2 JF, 2 NB, 2 NM, 2 OD, 2 VQ, 2 WJ, 5 DN, 5 LF, 5 MO, 5 NN, 5 OX, 5 QV 5 SI, 5 UQ, 5 YI, 6 AH, 6 GH, 6 GM, 6 LF, 6 NF, 6 QB, 6 TM, 6 VP, 6 UD.** French: **8 AQ, 8 BAP, 8 BC, 8 BU, 8 DE, 8 DU, 8 ÉM, 8 FK, 8 NS, 8 QG, 8 SSU, 8 UU, 8 WK.** American: **1 AID, 1 ANH, 1 AQM, 1 AZR, 1 BDB, 1 BCU, 1 BOA, 1 CAB, 1 CKP, 1 GV, 1 HN, 1 IL, 1 OW, 1 PL, 1 PY, 1 QP, 1 SF, 1 SW, 1 XZ, 2 APF, 2 BRR, 2 BGG, 2 CEI, 2 PD, 3 ADE, 3 ADQ, 3 ALQ, 3 BGF, 3 MF, 3 AIS, 3 HH, 4 TJ, 4 XE, 2 AG, KDKA, NKF.** Belgian: **P 2.** Swedish: **SMYY, SMZV.** Danish: **7 EC.** Candian: **1 AR, 1 DM, 2 CG.** Finnish: **2 NCA.** Unknown: **LOAA, NOBG, WGH.** (o—v—o.) (G. J. Whitehouse).

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CORRESPONDENCE

The Best Crystal Circuit.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have concluded a prolonged period of experimental work with crystal rectifiers with the object of determining the circuit yielding the best results. I find an arrangement similar to that suggested in *The Wireless World and Radio Review* of April 20th, 1924: ("What is the best circuit for crystal reception?") the most efficient of all I have wired-up.

It consists of 22 turns of No. 20 bare wire wound over six grooved ebonite strips spaced round the circumference of two wood discs one foot in diameter. The crystal is mounted on the top of one of the discs with the aerial and telephone terminals. The earth terminal is on the other disc. Connections from aerial and crystal terminals to coil are made by short pieces of flex to which small spring clips are soldered. Aerial and earth are first-class; twin wires 90 feet over all. Aerial clip is best on the eighth turn and the crystal on third.

Position of aerial clip is important; very little difference is observable when the crystal clip is varied. A two-valve note magnifier attached to this arrangement gives a volume of sound on 2 LO much too powerful for a large-sized room.

The coil arrangement is bulky as it stands but a little ingenuity could easily hide this and make it presentable for use in a living-room.

Short pieces of wood should be fastened to the bottom disc so that the coil may stand firmly.

I recommend this circuit to those who want really good crystal reception.

E. J. BRAY.

Finchley, London, N.3.

Remarkable Transatlantic Reception.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Since the publication in your issue of October 15th of a letter from Mr. D. B. Knock (6 XG), in which he tells of the reception of KDKA on about 65 m. at my station, I have had so many letters and enquiries relating to it, that I feel I must write to you to clear up one or two points. For some time Mr. Dootson (5 KL) of Bolton and myself have been experimenting with short wave tuners, and the tuner in use on that particular night was one that had been made up—with slight modifications—by Mr. Dootson from an article published in *Q.S.T.* and had been sent to me to test. In this test I was kindly assisted by Mr. Knock, who at that time was staying with me.

There is one particular point in the letter from Mr. Knock relating to my aerial which I hope you will correct, as this discrepancy has been pointed out to me several times. The aerial is supported at the lead-in end by a 70 ft. steel mast, the actual height there being 68 ft., and at the far end the height is about 45 ft.

E. H. WILDING (6 KB)

Porto Rico Broadcasting.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In regard to my reception of station WKAQ, San Juan, Porto Rico, West Indies, on the occasion of the Madrid tests (28th September 1924), I have received confirmation of this in a letter dated Porto Rico, October 21st. I shall quote some parts of the letter which may prove of interest to readers.

"Our station is erected in the centre of the City of San Juan, Porto Rico, the Island of Enchantment, and its distance records are British Columbia in Canada and *Scotland in Great Britain.*

"Its equipment consists of a Western Electric 500 watt installation. The Radio Corporation of Porto Rico is affiliated with the International Telephone and Telegraph Corporation of New York, as is our sister station PWX of the Cuban Telephone Company at Havana, Cuba.

"At the present time we are broadcasting every Tuesday and Thursday from 9 to 10.30 p.m., and Wednesday from 8 to 9 p.m., Porto Rico time (four hours behind G.M.T.).

Inverness. JAS. MACINTOSH.

Daylight Reception of U.S. Amateurs.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In the early morning hours of Sunday, November 23rd, I heard the American amateur 1 PL sending "CQ u 1 PL" on a wave of approximately 80 metres, and continued to receive him again at intervals until 9.45 a.m.

It is a definite fact that I heard him at a quarter to ten in the morning, and although his signals were weak they were distinctly readable.

Is this a record for the late morning reception of Americans? If not, what is the latest hour at which they have been heard?

E. KUNZLE.

Birmingham.

Thermoelectric L.T. and H.T. Supply.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—You mention in your issue of November 26th a thermoelectric device designed for the purpose of supplying filament and plate current, giving various details mostly in its favour.

You do not, however, mention the worst and most notorious failing of all types of thermopile—inefficiency. In order to expend about 0·54 watts of energy in the filament of three 3 v. ·06 valves, you must use a heater consuming 500 or 600 watts. Unless you are in possession of heat otherwise going to waste it can never "pay" to use a thermopile, as the heat conduction of the elements takes so much more power to useless waste than you get back from the electric effect.

It is only fair to your readers to point this out, as it is cheaper to use dry batteries that cost 4s. 6d. to replace every three months than to pay 1½d. per hour for heating current in the thermoformer.

Incidentally, it is highly unlikely that the thermoformer would do for anything but a dull emitter valve owing to the high specific resistance of metals giving a large thermoelectric effect with each other.

I. A. J. DUFF, B.A.

Golders Green, London, N.W.

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AMONG THE SOCIETIES.

The Annual General Meeting of the Croydon Wireless and Physical Society, held on December 9th, revealed the society's strong financial position and its excellent prospects during the coming months. The President of the Society is Mr. W. Thompson, M.A., B.S.C., and, included among the Vice-Presidents, are Major J. Erskine Murray, D.Sc., F.R.S.E., and Mr. G. F. Mansbridge, M.I.E.E.

* * * *

A novel evening was spent by members of the North Middlesex Wireless Club on November 28th, when Mr. J. S. Wilson lectured on "Scientific and Other Curiosities." The paper was unique in that the word "wireless" was scarcely mentioned.

* * * *

A masterly talk on "Broadcasting" was given before the Borough of Tynemouth Radio Society on Thursday, November 27th, by Mr. E. Lynch Odhams, the station director at 5 NO. After an instructive description of the present arrangements at the Newcastle broadcasting station, Mr. Odhams gave particulars of the improvements to be effected in the near future.

In the course of his talk the speaker congratulated the Society on its efforts to reduce interference from "howling."

* * * *

The East Grinstead and District Radio Society held its first ordinary meeting at "Radio Hall," London Road, on Thursday, November 27th, when over 40 members and friends were present. The feature of the evening was a talk on "Wireless Valves," by Mr. J. B. Price, M.I.E.E., who illustrated his instructive discourse with demonstrations and blackboard diagrams.

* * * *

One of the youngest wireless societies is that at Englefield Green, near Egham. Although membership is at present small, there are indications that this will increase in the near future. At a recent meeting, held at the "Barley Mow," Mr. Holford gave instructive hints on purity in broadcast reception. On December 17th Mr. Grant lectured on "Component Parts—Doubtful and Otherwise."

* * * *

Unusual interest has marked the recent activities of the Woolwich Radio Society. Subjects dealt with in lectures and demonstrations have included "Home Made Loud Speakers," by Captain Hughes, and "Remote Control of Wireless Receivers," by Mr. Smith. A lecture entitled "Food for Thought" was given on November 26th by Mr. Bartle, who put the question, "Are we really making progress in wireless matters?" The speaker contended that in many respects components of to-day were inferior to those of five years ago, and a keen and long discussion ensured.

* * * *

The second of a series of elementary talks on "Magnetism and Electricity" was given by Mr. Usher before the Tottenham Wireless Society on November 26th. Mr. Usher dealt with the electron theory, conductors and insulators, and Ohm's law. A number of interesting experiments accompanied the lecture.

* * * *

Some novel switches, suitable for reflex work, and comparative tests were shown at the Beckenham and District Radio Society's meeting on December 4th. Many modifications and improvements were shown on the blackboard.

* * * *

An instructive paper on "Accumulators" was read by Mr. G. P. Cosway at a recent meeting of the Nuneaton Radio Society. In addition to providing useful information on the care of accumulators, the lecturer handed round samples of various plates for the inspection of his audience.

* * * *

"Tools and How to Use them," formed the subject of an informative lecture given recently by Mr. W. J. Poole before the Dorking and District Radio Society. Particular attention was given to the cutting out, trimming up, drilling and polishing of ebonite. A special series of talks on the theory of wireless reception has been organised for the benefit of members. The first talk will be given by Mr. L. F. Cooke.

* * * *

"A Glimpse into the World of a Millionth of a Millimetre," was the title of an absorbing lecture given to the Northampton and District Amateur Radio Society on December 8th. The lecturer, Mr. R. G. Turner, dealt with the ultimate division of matter and the wonderful possibilities of the release of atomic force.

TYNEMOUTH RADIO SOCIETY.

Owing to recent confusion as to his address, the Hon. Secretary of the Borough of Tynemouth Radio Society wishes it to be announced that all communications for the Society should be addressed to him at Y.M.C.A. Building, Bedford Street, North Shields.

(Correspondence intended for Hon. Secretaries of Societies may be addressed c/o the Editor of this Journal.)

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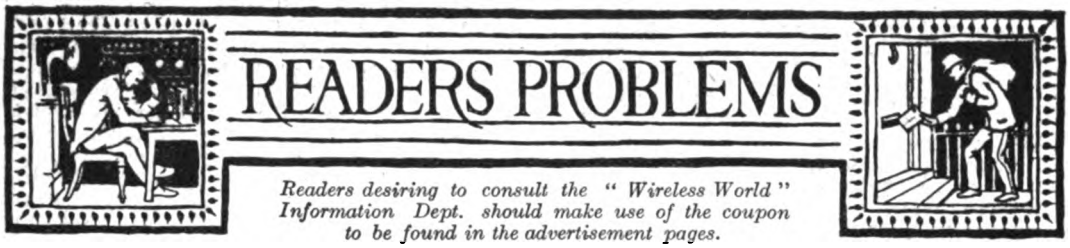
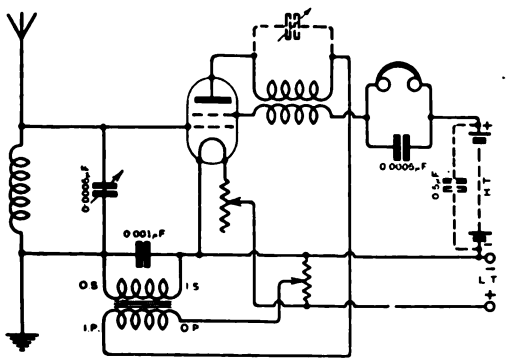

READERS PROBLEMS
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

A FOUR-ELECTRODE SINGLE VALVE REFLEX.

SEVERAL readers have asked whether it is possible to use a four-electrode valve in a reflex circuit, in such a manner that the valve is caused to perform the three functions of high frequency amplification, rectification and low frequency amplification simultaneously.

This certainly is possible, and we illustrate below a suitable circuit. The inner grid of the valve functions in the same manner as the grid of the ordinary three-electrode valve. The outer grid performs exactly the same functions as the anode of an ordinary valve. The anode of this valve serves merely for rectification purposes and takes no part in amplification at either frequency, both frequencies of amplification taking place between the filament and outer grid, the electron emission being controlled by the potential of the inner grid in the usual manner.



A reflex circuit for the four-electrode valve.

Incoming signals are amplified at high frequency by means of the outer grid and high frequency transformer. High frequency impulses pass through the primary of the H.F. transformer and across the telephones by means of the 0·0005 μF condenser provided. These high frequency impulses are rectified between the filament and anode by suitable adjustment of the potentiometer, and then the resultant L.F. impulses pass through the H.F. transformer secondary, the L.F transformer primary, and then through the intermediary of the transformer they reach the inner grid and are amplified at low frequency between the filament and outer grid, passing through the telephones in the usual manner.

The low frequency transformer should be of low ratio, otherwise the set will be extremely unstable. The high frequency transformer is preferably of the plug-in aperiodic type in order to simplify tuning. The correct functioning of this circuit depends on a suitable adjustment of filament rheostat and potentiometer. By suitable adjustment of these, strong reaction can be obtained, and also oscillation, if the filament temperature is too high.

The impression seems to have gained ground that the four-electrode valve is the product of the past few months, and that its only purpose is to eliminate the H.T. battery. This is quite incorrect, these valves having been in existence some considerable time.

THE PROPAGATION OF WIRELESS WAVES.

IN connection with the night effect mentioned in a recent paper before the Radio Society of Great Britain by Mr. Barfield, a reader writes to suggest that the increase of signal strength at night time may be due to the fact that the ether is undisturbed by heat or light waves from the sun. He suggests the possibility that wireless waves may have greater difficulty in passing through the ether when it is disturbed by these short wave radiations.

The study of wave motion in material media reveals the fact that the amplitude of the waves at a given distance from the source is unaffected by interference from other waves in the intervening distance. The instantaneous value of the amplitude at a given point may be reduced by interference from waves from another source, but at other points the amplitude will be increased by an equal amount. This principle holds good for all types of wave motion, and for mathematical proof the reader is referred to text-books on physics. It was pointed out in the original paper that no effect near the surface of the earth would account for the difference in signal strength experienced, and that the signal strength over short distances was unaffected. If the light waves in any way affected the propagation of wireless waves, the difference in signal strength could be detected over short as well as over long distances.

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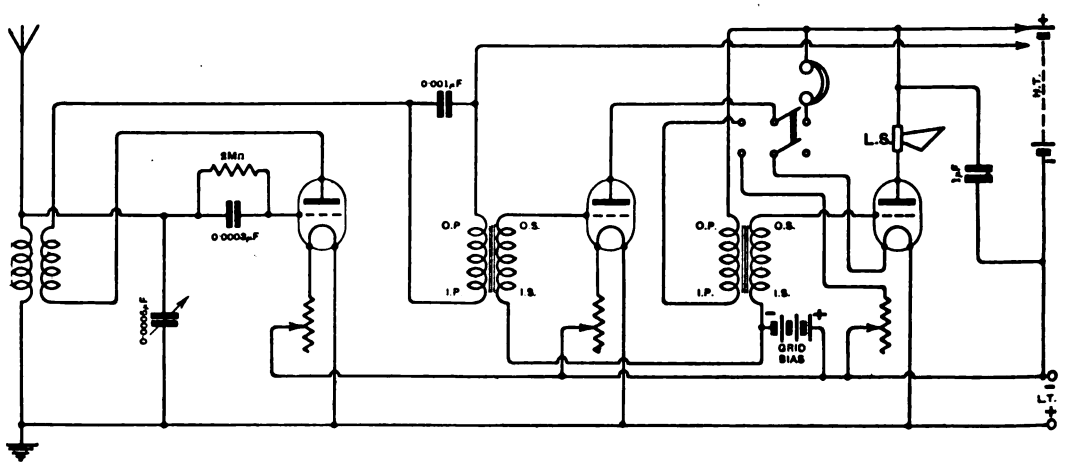
SWITCHING ARRANGEMENTS OF A THREE-VALVE SET.

A CORRESPONDENT has written to ask for a reliable three-valve circuit with simple control, to operate a loud speaker at good strength on a good outdoor aerial about 40 miles from London. He desires that the circuit be arranged so that by the movement of a simple switch the second L.F. amplifier is turned out, the loud speaker switched off, and the 'phones automatically connected in the anode of the second valve. He does not at any time wish for the 'phones to be connected in the anode circuit of the third valve, nor the loud speaker to be connected in the anode circuit of the second valve.



A three-valve set for telephones or loud speaker.

We illustrate such a circuit above. The aerial tuning condenser and the reaction coil are the only two controls; thus tuning is not difficult. It will be seen that the switch provided automatically turns out the filament of the third valve and places the telephones in the anode circuit of the second valve in place of the primary of the second transformer. The telephones and loud speaker are always operating after the same number of valves respectively, and no movement of the switch will alter them.

This set should be quite suitable for the purpose desired, and should, in addition, be quite capable of receiving other B.B.C. and continental stations.

CONNECTING "R" VALVES IN PARALLEL TO OBTAIN INCREASED VOLUME.

A READER writes to ask if it would be possible for him to gain increased volume and clarity from his loud speaker without going to the expense of purchasing a valve of the D.E.5 type, by connecting two "R" type valves in parallel in the last stage of his amplifier.

It would certainly be possible to obtain a greater volume by connecting two "R" valves in parallel than could be obtained by using one valve only, but at the same time it must not be thought that equal results to the D.E.5 could be obtained from the point of view of freedom from distortion. The reason for this is that the length of the straight portion of the valve characteristic available is much greater than in the case of the "R" valves in parallel, so that a much greater amplitude can be applied to the grid of the valve without producing distortion. If, however, it is expressly desired to obtain greater volume without the use of power valves, this method of connecting "R" valves in parallel is greatly to be preferred to the adding of another stage of low frequency amplification, using "R" valves.

LECLANCHE CELLS FOR H.T.

A READER asks whether it would be feasible to use a large number of wet leclanché cells, such as are used for electric bell work, as the source of H.T. supply to his four-valve set, in order to eliminate the necessity of constantly purchasing H.T. batteries.

There is no reason at all why these cells should not be used for the purpose named, but, owing to their great bulk and weight, they could only be used in cases where the position of the set was absolutely permanent. Thirty of these cells connected in series would be the minimum number possible for supplying H.T. to ordinary types of receiving valves. There is no necessity for the size usually employed for bells to be purchased, a much smaller size being sufficient.

The cells should preferably be placed in a box protected from dust, and should be emptied out and cleaned every four months, fresh sal-ammoniac solution being put in. We would point out, however, that H.T. batteries can now be purchased which will serve a four-valve set for many months without developing noises, and the cost of these H.T. batteries is less than half that of the leclanché battery.

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THE WIRELESS WORLD AND RADIO REVIEW

PRICE 4D NET

A TWO-VALVE PORTABLE RECEIVER

No. 281 [No. 14 Vol. XV]

THREE-VALVE "IDEAL" SET

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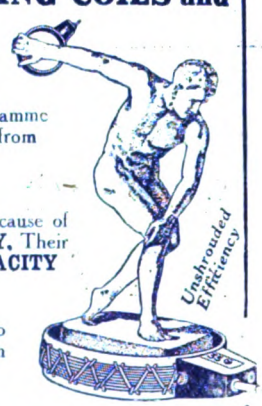

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

By The Editor.

THE POST OFFICE AND RECEIVING LICENCES.

COMMENCING from January 1st, the Post Office is introducing certain changes in wireless licences for receiving. Instead of the different types of licences for receiving purposes which have been issued in the past, there will now be only one type of licence, and this will be obtainable from the Post Office on payment of 10s. per annum.

The experimental receiving licence which hitherto has been issued from the General Post Office has been abandoned, whilst the B.B.C. licence issued at local post offices has also been superseded by the one general type of licence for receiving. The principal change involved is that the new licence does not make any stipulation with regard to the class of apparatus to be employed, whereas it will be remembered that the B.B.C. licence was conditional on the apparatus used being of British manufacture. The stipulation made in the past that constructors might not use any components that were not of British manufacture, and that B.B.C. licence holders must use British sets, was one which was made in the interest of the British wireless industry in order to give it the opportunity of establishing itself before it was brought into competition with foreign manufacturers. There is no doubt that at the time it was made, this concession to the British wireless industry was a very fair one, because it must be remembered that in the United States of America, in particular, broadcasting had existed for nearly two years before it was introduced in this country, and as a consequence manufacturers there were already organised, so that their output of wireless apparatus was large, and they could have flooded the market in this country long before the British manufacturers would have had time to get in themselves.

The removal of the ban on the use of foreign apparatus is an indication that in the opinion of the Postmaster-General, sufficient time has now been allowed for the British wireless industry to establish itself, and that it should be in a position to compete with foreign imports.

Just how far the industry may suffer as a result of the competition depends very largely upon the attitude which the public in this country may adopt towards foreign products. We believe that the public here is now sufficiently well educated in wireless to appreciate apparatus and components on merits, and that they are not slow to recognise the properties of really efficient instruments. The net result, therefore, is likely to be keener competition in the production of really high-grade apparatus at reasonable prices, and in this direction we believe from our own observations that the British manufacturer has good reason to feel fairly secure. In the majority of cases the products which we have seen of manufacturers abroad do not compare favourably with those of our own producers.

There is no doubt that a considerable amount of foreign apparatus will find a ready sale in this country, if only on account of its novelty and the interest which the experimenter will find in trying out new components with which he has not previously had the opportunity of familiarising himself, and in this connection we may mention that now that foreign components can be used legitimately, it will be our endeavour to make reference to such components as are of particular merit and available in this country.

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Referring again to the fact that the Post Office will now issue only one kind of licence, we observe in particular that this indicates that the Postmaster-General no longer recognises any distinction between the experimenter and the broadcast listener, in so far as receiving is concerned, and therefore the only licence which can be regarded as applicable to the experimenter alone is the transmitting licence.

This decision brings us more into line with the state of affairs in the United States of America. There, however, for receiving no licence is required and no annual payment is made. Licences need only be obtained where it is desired to transmit.

Special reference is made under the new licensing regulations to portable receivers. It is stated that where a portable station is used, in addition to a fixed station, a second licence is necessary. It would be interesting to know what attitude the Post Office would adopt towards those who may be in the habit of using more than one receiver in the same room or building in the course of experimental work. It is surely not intended that the regulations should require that an experimenter should purchase licences in proportion to the number of complete sets he owns, and may make use of in turn or collectively from time to time.

THE B.B.C. AND CHRISTMAS PROGRAMMES.

PROBABLY no two people would have just the same idea as to what would constitute a suitable broadcast programme for Christmas time, yet we doubt whether this Christmas the British Broadcasting Company has come anywhere near meeting what the public might reasonably have expected at such a season.

Those who paid sixpence for their Christmas number of the official organ of the B.B.C. and turned expectantly to the pages giving details of the programme arranged for Christmas, must have felt sadly disappointed at the prospects held out to them.

To begin with, one would surely have been justified in expecting some wireless entertainment on Christmas Day at an earlier hour than seven in the evening.

The British manufacturers who are the shareholders of the B.B.C. have devoted considerable energy to pushing their sets as Christmas presents, and have expended a great deal of money in advertising for the Christmas season. This has all been done with the object of inducing the public to purchase wireless sets as Christmas presents, and yet on Christmas Day it is necessary to wait until the evening before it is possible to give the new acquisitions a trial. Children, too, for whom Christmas season means so much more than to grown-ups, are many of them expected to be in bed by this hour, and one can imagine the disappointment which they feel at having had no opportunity of trying out the new present on Christmas Day.

Disappointed with what is provided for Christmas Day, one naturally turned to the programme for Boxing Day to see what better fare was in store for that holiday, but only to feel the same disappointment that no special effort had been made to provide a programme suitable for the occasion.

One might reasonably expect a programme a little out of the ordinary, and specialised items would not be expected to make a general appeal on this day, and yet the programme shows that very little departure has been made from the general routine.

There are two items in particular which seem unsuited to the day. These are both of such a character that they make an appeal to only a limited number of listeners. We refer to the fortnightly bulletin of the Ministry of Agriculture and the talk of the B.B.C. music critic. One would have expected that these items could have been held over for another more suitable day. It is difficult to suppress the feeling that if it were not for the fact that broadcasting in this country is without competition that programmes for the Christmas holidays would have received more consideration, and have been compiled so as to make a more general appeal to the majority of listeners at that time.

At the time of writing we still hope that the B.B.C. will recognise their shortcomings and introduce some alterations to their official programme.

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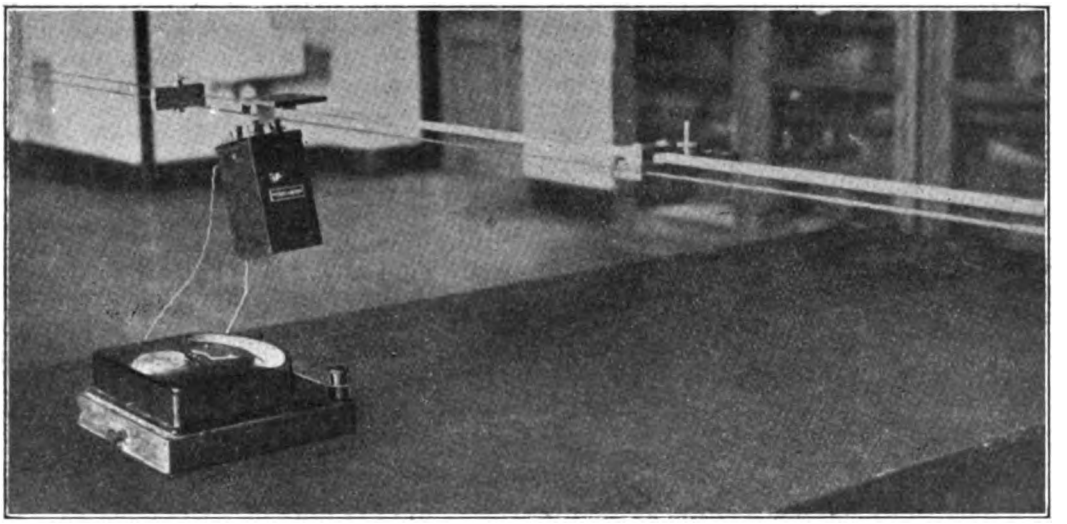

On the table is a milli-voltmeter which, with the thermo-junction just above it, measures the voltage between the parallel wires.

STANDING WAVES.

The author describes experiments with standing waves on a parallel wire system. The length of short waves, for instance, of 10 metres, may be directly measured with the apparatus described below.

By GUSTAV LAMM and EDWARD GRAHAM.

INTRODUCTION.

IN an article entitled "Standardising the Ultra-Radio Frequencies" (*Radio News*, April, 1924), the authors, Messrs. Dunmore and Engel, show how it is possible to obtain standing waves on a parallel wire system, and to determine the wavelength with good accuracy by direct measurement.

The wavelength used in their experiments was of the order of 10 metres (30,000 kilocycles). By causing the harmonics from an oscillatory circuit to interfere with the 10-metre wave that can be measured directly on the parallel wire system, it was possible to calibrate oscillatory circuits, condensers, and so on, quite accurately. However, as their work seems to be purely practical, we have treated the problem from both a practical and a theoretical point of view.

A well-known fact is that the propagation of electro-magnetic waves along a wire is slower than the velocity of light. This fact Dunmore and Engel appear not to have taken into consideration. Thus, the object of the following work is to obtain standing waves on a parallel wire system by induction from a valve generator (wavelength about 10 metres), to study the wave shape and to determine the accuracy with which the wavelength of the waves may be measured.

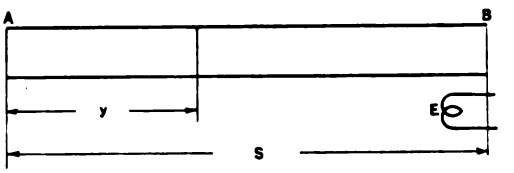

Fig. 1. Two parallel wires, AB, of length S are excited by a valve generator E.

THEORETICAL DISCUSSION.

If we induce an alternating potential E on the wire system AB (Fig. 1), standing waves will be set up. Further, if the wires are short-circuited, for instance at end A, we have fixed a nodal point. At this point

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the potential between the wires must be zero. Starting from A, the voltage between the wires can be measured, the distance between A and the point where the measurement is made being Y. The wavelength is determined by finding consecutive nodal points, which are a distance of half a wavelength from each other. A theoretical analysis will show, however, that the voltage never can fall to zero, except at the point A, because of damping, but falls to a certain fraction of the maximum value.

metres, and a parallel wire system consisting of copper wire (diameter 2 mm.) 50 millimetres apart, as in these experiments, we obtain

$$K = \frac{25Y}{\sqrt{V}}$$

where V is the frequency.

For the 10 metres wave, $K = 0{\cdot}000782$—a very small figure indeed.

In Fig. 2, K is plotted against the wavelength. Thus we have found the cor-

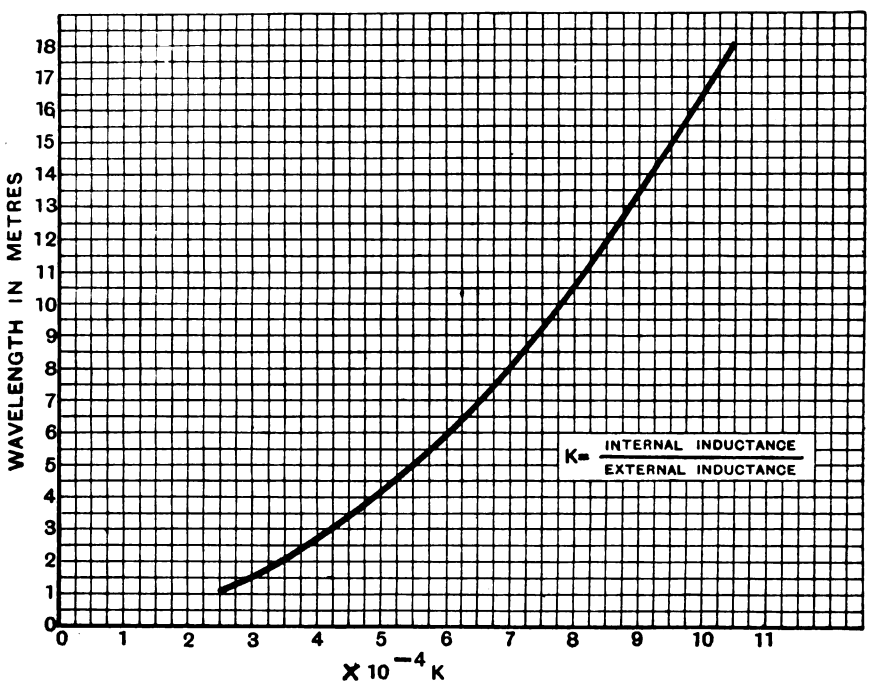

Fig. 2. A curve showing the ratio of the internal to the external inductance of the system (K) at various wavelengths.

Moreover, the points of minimum voltage will be removed from the theoretical nodal point (corresponding to the wavelength) in such a manner that the measured wavelength is a little too short.

If Y_n indicates the nth measured nodal point ($A=o$), n a small figure (1, 2, 3), and λu_o is the wavelength corresponding to the propagation of light, we have

$$\lambda u_o = \frac{2}{u} Y_n \ (1 + K)$$

where K is the ratio of the internal to the external inductance of the system.

For wavelengths between 5 and 20 rections, provided the oscillation is a pure sine wave.

It still remains to investigate to what extent the impedance of the circuit will alter the shape of the curve. It will, of course, be understood that the influence of the measuring circuit will increase as its impedance becomes smaller compared with the characteristic of the parallel wire system, its characteristic being about 500 ohms for these frequencies. We obtain by measurement a figure that is proportional to the r.m.s. value of the potential at the point of measurement, or if the method of

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measurement follows the square law, proportional to the square of it. A mathematical analysis will show that the measured voltage can be expressed by the following formula, where

V_y is the voltage of the pure sine wave at point y,

$$V = V_y G\,; \quad G = \frac{1}{\sqrt{N^2\phi(y)^2 + 2N\phi(y)\theta + 1}}$$

$$\phi(y) = \frac{\cos \propto (S-y) \sin \propto y}{\sin \propto S}\,; \propto = \frac{2\pi}{\lambda}$$

where N is the ratio between the characteristic of the wire system and impedance of the measuring circuit, λ the wavelength in metres, S the total length of the parallel wires, and θ is the ratio between the reactance component and the impedance of the measuring circuit. θ may have any value between -1 and $+1$. If the measuring circuit is a pure resistance, we obtain the following expression for the voltage:

$$V = V_y \frac{1}{\sqrt{N^2\theta(y)^2 + 1}}$$

As the impedance of the measuring circuit gets greater, N gets smaller, and if N approaches zero,

$$V \equiv V_y$$

The analysis above is made assuming that the wire system is short-circuited at end A, and opened at end B. However, we can connect a resistance between the terminals at end B, and carry out similar calculations. The result will be that we can obtain any form of curve from a pure sine wave. How it will come out depends upon the impedance and the phase angle of the measuring circuit, the length of the wires, and the impedance inserted at the end terminals of the wires. If we want to get the original curve, the impedance of the measuring instruments should be great compared to the characteristic of the parallel wires. A measurement of the wavelength, however, is always possible.

PRACTICAL WORK.

The wire-system, mentioned above, has proved to be quite satisfactory, its total length being about 16 metres. The wires are carried by heavy ebonite blocks at the ends and stretched with weights (100 kilograms).

The diagram is given in Fig. 3. In the generator C, the oscillation and grid coils consist of a single turn of copper ribbon (0·5 × 10·0 millimetres of a diameter of 20 centimetres) mounted on a coil-holder of the ordinary type, the grid coil being mounted on the moving holder. The condenser C_1 is variable (max. 0·0001 μF). The coil L must be wound with a minimum of self capacity; 14 turns of No. 15 on an 8 centimetres former is a very good coil for that purpose. The method of measurement using vacuo-thermo-junction with millivoltmeter D has been generally adopted. The resistance of this measuring circuit is about 60 ohms. The photograph at the head of this article shows the wires and the measuring arrangement. The scale is graduated in millimetres, thus allowing very accurate readings to be made.

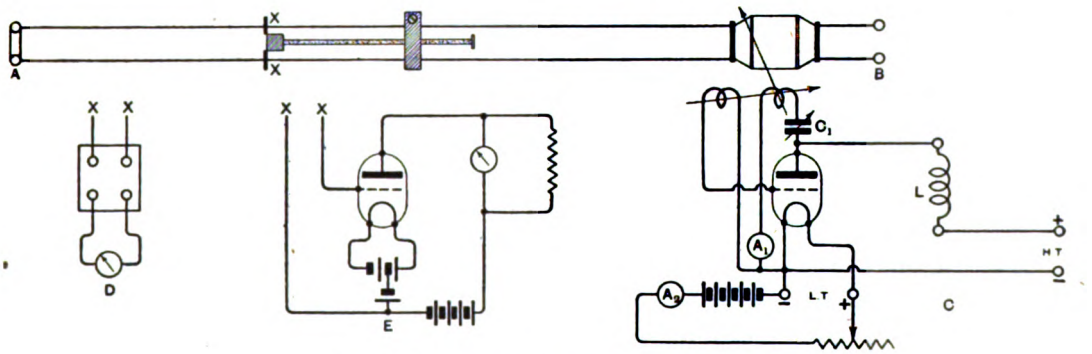

Fig. 3. The arrangement of the apparatus.

During all measurements the wire system was coupled at the B end, the mutual inductance between the coil of the oscillator and the wires being so small that it can be

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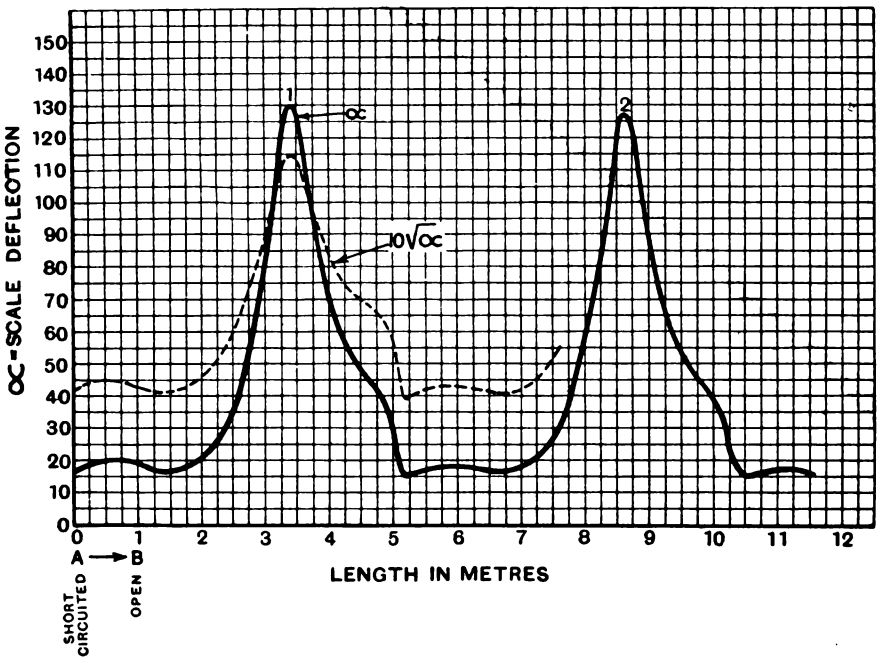

Fig. 4. The curves show the deflection of the measuring instrument at various points of the parallel wires.

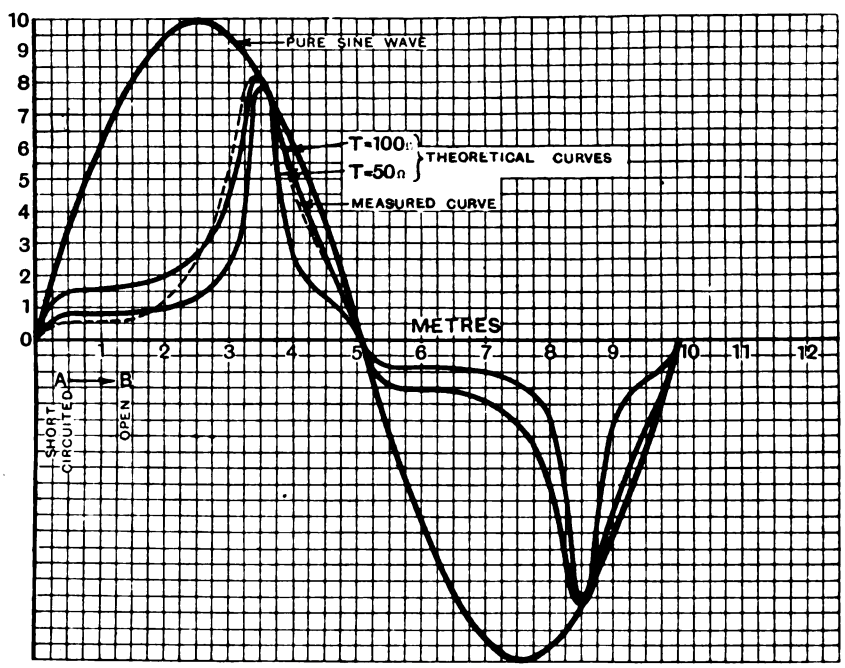

Fig. 5. The curve actually obtained, and the calculated curves. These show the effect of connecting a measuring circuit to the wires. The applied sine wave has a wavelength of 10 metres.

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neglected. The measuring-cursor is moved from A ($A = 0$) towards B, and the readings obtained on the instrument immediately put down on a sheet of squared paper. A curve directly obtained by measurements is marked $\propto$ (scale indication) and a voltage curve is marked $\sqrt{\propto}$.

Curves obtained are as follows :—

Fig. 4 ($\propto \sqrt{\propto}$).—The wires are connected at A and open at B. The curve shows a periodical character with a weak and a very strong maximum point per half period.

The dotted curve is obtained from measurements, and the other curves are obtained by calculation, the measuring circuit being considered a pure resistance load. The practical and the theoretical results coincide fairly well. The divergence between them is due to the fact that the measuring circuit never can be a pure resistance in practice.

Fig. 6 ($\propto$).—The wires are short-circuited at A; between the B terminals an electrolytic resistance is inserted. Any electrolyte

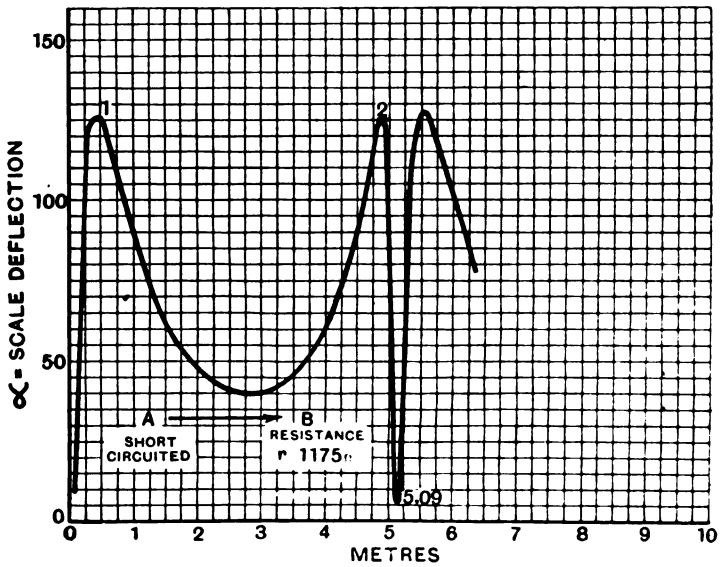

Fig. 6. The results obtained when a resistance is connected between the ends of the wire at B.

The reason why the curve does not drop to zero but gives a definite reading at the nodal points is because of electrical unsymmetry of the wires, causing a current to earth through the thermo-junction. (The theoretical minimum mentioned above should only be 0·000005 of the maximum indication). We have not been able to get rid of this unsymmetry but through proper adjustments of the coils, it was possible to reduce it very much. The dotted curve is obtained from square roots of the $\propto$ values put in a suitable scale. This is the voltage curve.

Fig. 5 ($\sqrt{\propto}$).—The wires are arranged as in Fig. 4.

having low conductivity and negligible rectifying properties may be used. As electrodes, copper ribbons have been adopted and arranged to give a minimum of capacity load. For each half period we get two points of maximum voltage, 1 and 2 from left to right, 2 being less than 1 up to a certain resistance value of the electrolyte after which 1 is less than 2. The resistance value making $1 = 2$ was determined by experiment to be 117·5 ohms (D.C. measured at 4 volts tension). We now have a very pronounced node round which measurements may be taken giving great accuracy.

(*To be concluded.*)

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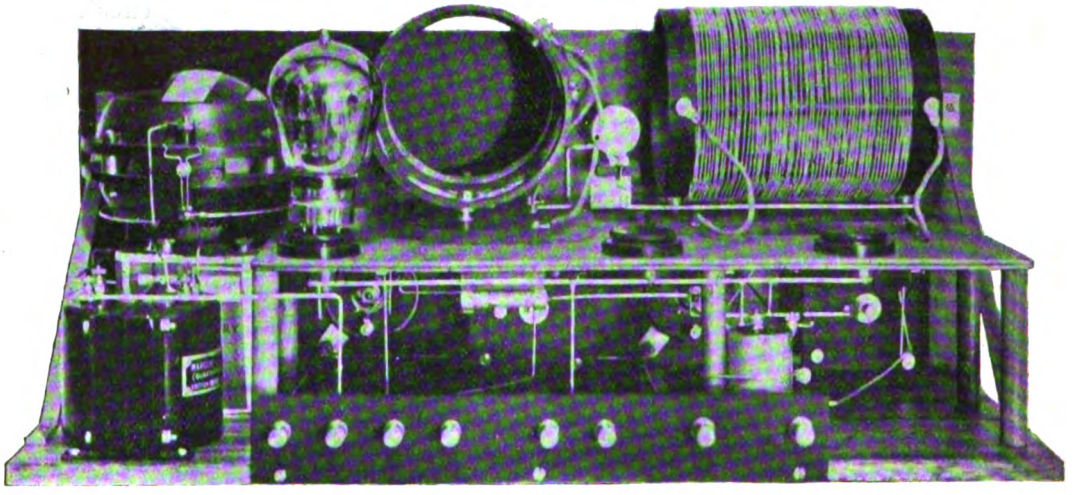

IDEAL RECEIVERS—II.

Under this heading the author will describe a number of receivers. Each instrument is to be built to meet certain requirements. No. I of this series, for instance, was designed for the man requiring a three-valve receiver having only one tuning control, and giving high quality amplification. A full discussion of the principles underlying the design and operation of the receivers, and, of course, complete constructional details will be given.

A THREE-VALVE RECEIVER

With one H.F., Valve Detector and one Stage of L.F.

By W. JAMES.

THIS instrument was designed for the man who has had a little experience in the construction of wireless apparatus, and requires a receiver which is easy to operate, and may be employed effectively in the reception of short wavelength or B.B.C. stations. One stage of tuned transformer-coupled high frequency amplification is employed with valve detector and one stage of transformer coupled low frequency amplification. A variometer is connected in the anode circuit of the detector to provide reaction effects, and a switch is employed to put the windings of the variometer in series or parallel, according to the wavelength of the signals being received.

DESIGN OF THE INSTRUMENT.

The general arrangement of the components and the method of mounting some of them may be gathered from the illustration at the head of this article. It will be observed that the front ebonite panel carries a base of wood, which in turn supports a platform of three-ply wood. The platform carries two removable tuning coils of special construction, and the three valve holders.

This arrangement was decided on because it permits one to change quickly the tuning coils or the valves. Further—and this is an important point to be observed in receivers which have removable coils inside the set—the whole of the wiring (with the exception of the wire connecting the transformer) is

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below the platform. The platform also covers the tuning condensers and filament resistances. Hence the wiring may be carefully arranged to give best results, and will not be disturbed during the operation of the set.

Of course, there are many ways of building a three-valve receiver, and many three-valve circuits, but in a receiver of this type it is quite desirable to depart a little from the ordinary type of set, and to devote the whole of one's skill to producing something which is as effective as the means at one's disposal will allow.

not compensated, the effect of bringing the two tuned circuits into resonance is to set up oscillations which reach the aerial. A little stray capacity, in so far as it produces a regenerative effect, may be helpful, but the effect of capacity between the elements of the valve is to weaken signals and to tend to produce instability. The use of the balancing condenser C_4 does not add another adjustment to the receiver, for once it is set there is no need to make a fresh adjustment until the coils or the valves are changed. As we are employing two tuned circuits, the selectivity will be fairly good without further

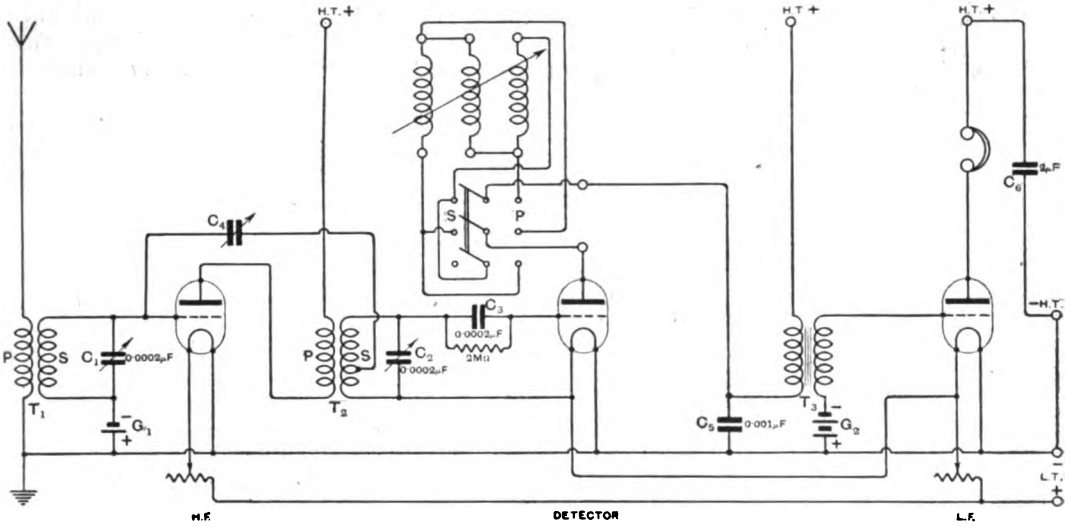

Fig. 1. The circuit of the three-valve receiver.

From the circuit of the receiver, Fig. 1, it will be seen that two high frequency transformers, T_1 and T_2, are employed. These are tuned by the variable condensers C_1 and C_2. As it is desirable that the condensers should be set at approximately the same scale reading when receiving, the coils are of identical size. A small variable condenser C_4 is connected between the grid of the first valve and a point on the secondary of T_2, to enable one to balance the circuit in the manner described by Prof. Hazeltine. When the circuit is suitably arranged and this condenser carefully adjusted, oscillations which may be generated in the detector valve circuit will not reach the aerial. Condenser C_4 compensates for the capacity between the grid and anode circuits of the first valve. If the stray capacity is considerable, and is coupled circuits, and attention may be directed to securing the strongest possible signals.

It should be well known to readers by now that for maximum signal strength and selectivity the condensers and tuning coils must have low losses. Desirable features in a tuning condenser are low losses and ruggedness. The condensers must, of course, be mechanically strong, and retain their calibration, but we emphasise low losses. Similarly, the tuning coils should be of a type which will permit handling without upsetting their characteristics, but special attention should be directed to their construction from the point of view of losses.

I would not care to say that tuning condensers of the metal end plate type are not so good as those having ebonite end plates,

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or to employ square-law type condensers which may be inferior from the point of view of losses to ordinary condensers. The condensers employed in the receiver illustrated have ebonite end plates, and are used because I have found them better than others. The capacity of the condensers should be decided bearing in mind the tuning range desired with a given set of coils, the degree of selectivity, and the signal strength. If large condensers are employed, the signal strength will be lower than when smaller condensers are used, but the selectivity will be better. In this receiver 0·0002 microfarad condensers are employed, as we require good signal strength, and because we know the selectivity will be reasonably good, as two tuned circuits are employed. Further, the degree of selectivity may be made suitable by adjusting the ratio of the high frequency transformers.

THE H.F. TRANSFORMERS.

The two transformers are of similar shape, and both are wound in the same manner. To obtain fairly tight coupling of the primary and secondary windings they are wound close together, the primary being inside the secondary. As we wish the coils to be as effective as possible, great care should be taken in their construction. Losses may be reduced by using a skeleton former, a fairly heavy gauge of wire, and by spacing the turns. The coils are therefore constructed after the style of the ones illustrated in my articles, "Wireless Theory."*

The construction of the formers for the coils may be gathered from Fig. 2. A piece of ebonite tube 4 ins. in diameter, with a $\frac{1}{8}$ in. wall, has pieces cut out, leaving a number of ribs. The cutting out is quite an easy job, it being only necessary to drill two or three holes, and then to cut away the sections with a hack-saw blade. Then the rough edges are filed, and the ribs chamfered. The coil former will be found to be springy. A short length of the ebonite tube is therefore cut along its length and a short piece removed. The ends are shaped as indicated in Fig. 2, and the ring then pushed inside the former. This ring prevents the ribs bending when the wire is wound.

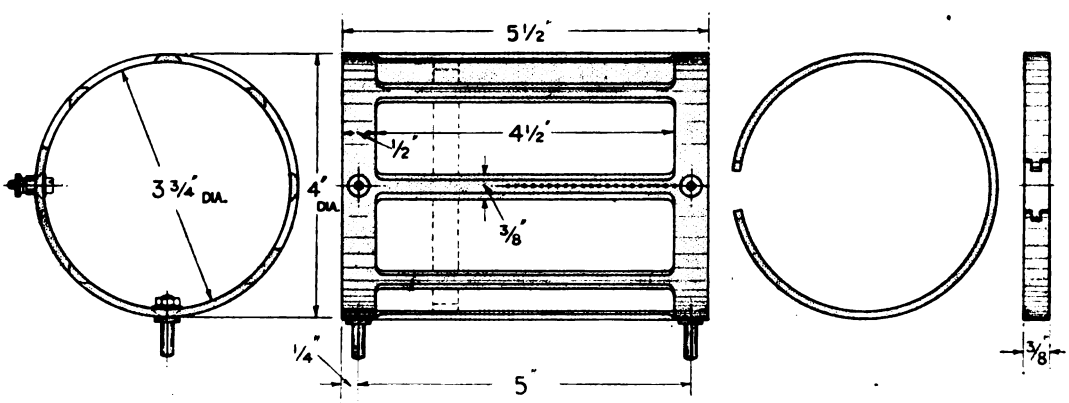

Fig. 2. Details of the formers for the coils. On the left is a part section. On the right is a sketch of the ring which is employed to prevent the ribs bending. The position of the ring is indicated by dotted lines.

The coupling between the primary and secondary windings is made fairly tight by putting the primary winding inside one end of the tube, and winding the secondary over the tube. For the broadcast wavelengths, the primary may have 10 turns of No. 20 D.S.C. and the secondary 60 turns of No. 20 D.S.C. Both windings are put on in the same direction.

To secure the primary winding a number of holes are drilled along alternate ribs. The primary is then wound on a former about 3½ ins. in diameter, the coil removed and put inside the coil former. Then each turn is held to the ribs by lacing them with a needle and cotton.

*December 19th, 1923, pp. 832-833.

(Constructional details will be given in the next issue.)

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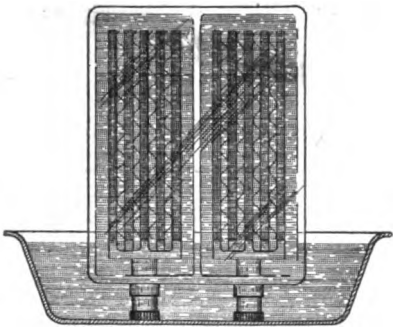
READERS' PRACTICAL IDEAS.

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Removing Accumulator Sediment.

PASTE falling from the plates of an accumulator after a while produces a clogged mass in the bottom of the accumulator, which must be removed before it becomes so deep as to reach the bottom of the plates. This sediment may sometimes be dislodged by vigorously shaking the cell after the acid has been removed and replaced by distilled water. Where the deposit has settled down and become hard it can sometimes be



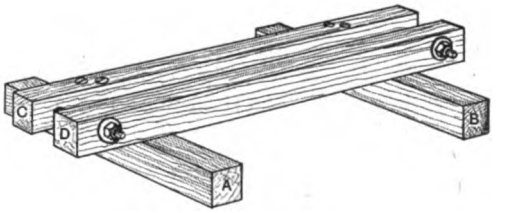
Thus inverted in a basin of distilled water the deposit now at the top becomes loosened and falls.

released by completely filling the cell with distilled water and leaving it inverted in a trough so that the paste falls as it becomes detached. Distilled water should fill the cell to the very top.

E. B.

Panel Holder.

AFTER wiring up a new set it is very convenient to be able to examine it before finally boxing up and while the apparatus at the back is still exposed, tests made as to the direction of connecting up the various transformers and the suitability of introducing fixed condensers, grid bias, etc. A useful stand can be made up out of four pieces of wood clamped together which will give support to the panel without interfering with the accessibility to the equipment.



Temporary panel support.

A length of wood is used with a cross section of 1 in. by 1 in. Two pieces are cut off about 7 ins. long and another two pieces about 12 ins. long. One of the longer pieces is securely screwed to the two shorter pieces as shown, whilst by means of a pair of bolts the remaining piece of wood can form a clamp suitable for gripping the edge of the panel. The panel simply stands edgewise, resting on the cross-pieces A and B, while the piece D is clamped up as far as it will go towards C, firmly gripping the edge.

J. G. F.

Positive Resistance Lock.

WHEN turning off the current supply to a valve filament by rotating the knob as far as it will go in the direction of the minimum setting, one can never be quite sure that the circuit is entirely broken. To ensure that the very minimum has been reached the pointer may be constructed from a piece of soft brass spring and

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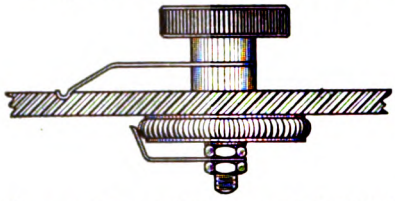
by bending it round in the manner shown can be made to engage in a small depression in the panel. The indentations are made with the point of a drill, whilst the spring



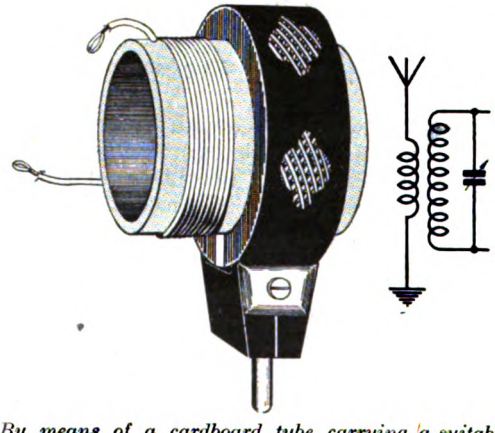
A springy pointer resting on an indentation makes a good stop.

should not press too firmly on the face of the ebonite or the surface will become cut. This arrangement produces a positive lock and it can be at once seen as to whether the rheostat has been rotated to the limit of its movement.

R. H.

Loose Coupling With Plug-in Coils.

A DIRECT coupled receiver can be converted to a loose-coupled set by inserting an insulating tube in the centre of the coil and winding on the required number



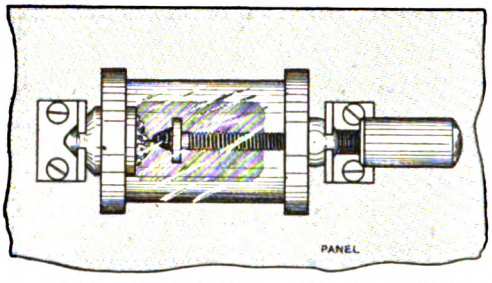
By means of a cardboard tube carrying a suitable winding for aerial tuning a direct coupled receiver can be easily converted to a loose-coupled set.

of turns. Almost any degree of coupling can be obtained by suitably spacing the turns away from the side of the plug-in coil and thus not only will the selectivity of the receiver be improved but a much improved control may be obtained over oscillation in a set making use of reaction.

R. H. B.

Illuminating the Crystal Detector.

CRYSTAL detectors cannot always be adjusted or touched and are difficult to adjust when the contact is not well illuminated. Where a crystal is used in conjunction with a valve, the light from the valve filament may be used to illuminate

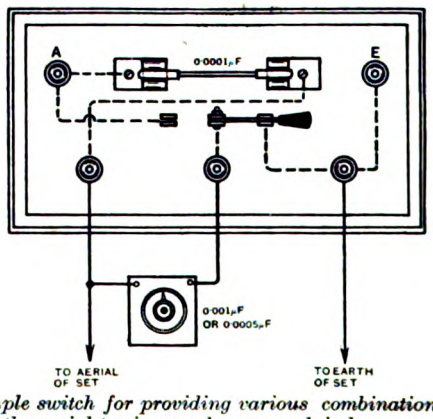


The light furnished by the valve of a crystal and valve receiver can be made to illuminate the detector contacts by placing the valve immediately beneath the detector and cutting away the panel.

the contact. The suggestion is made here that the valve is set up immediately behind a hole in the panel over which the crystal detector is mounted. Light thus passes right through the detector, giving good illumination to the point of contact. H. J. S.

Aerial Condenser Switching.

AN examination of the accompanying diagram will reveal that by connecting up the panel in the manner shown a variety of



Simple switch for providing various combinations of the aerial tuning condensers and inductance.

aerial connections are obtainable, consisting not only of the series and parallel arrangement, but provision is also made to employ condensers connected simultaneously in series and parallel with the tuning inductance.

C. R. L.

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A TWO-VALVE PORTABLE SET.

The instrument described below was designed to be really portable; therefore the whole of the equipment is arranged in an attaché case, the frame aerial being in the lid. It will give good signal strength from 10 to 15 miles from a broadcast station, and should appeal to those readers who live in a flat, or who find it difficult to erect an aerial. This receiver also has the advantage that it can be carried from room to room without the horror of trailing wires.

By H. J. CLARKE.

THE first step should be to secure an attaché case measuring approximately 17 ins. by 10 ins. by 5 ins. deep.

Then cut the ebonite panel to size, which in this instance is 10$\frac{1}{8}$ ins. by 8 ins. by $\frac{1}{4}$ in., the width of the case being 10$\frac{1}{8}$ ins. When the panel has been fitted to suit the case, it can be marked out and drilled from the dimensions of Fig. 1. Next construct the aerial and reaction coils. These are two basket coils consisting of cardboard formers of the dimensions shown in Fig. 2, wound with wire. The aerial coil has 30 turns of

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No. 28 D.C.C., and the reaction coil 50 turns of No. 36 D.C.C. The aerial is secured to the panel by a 4 B.A. screw, and is spaced from the panel by the thickness of two nuts upon a piece of 2 B.A. rod, and is secured by a nut placed on each side of the former. This rod passes through the former of the aerial coil and the panel, and

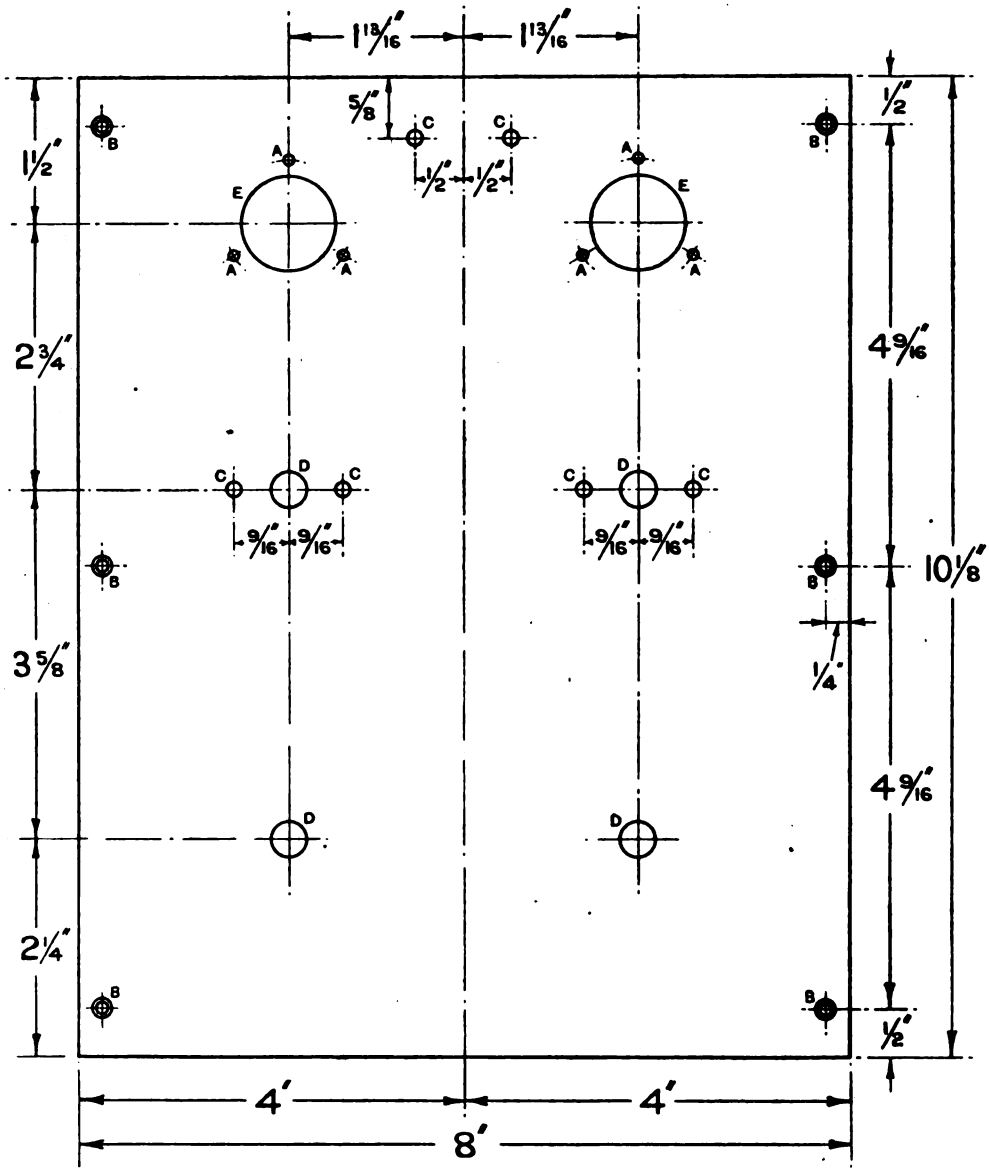

Fig. 1. Drilling details of ebonite panel. A, 3/32 in. dia.; B, ⅛ in. dia., countersunk for No. 4 wood screws; C, 5/32 in., dia.; D, ¾ in. dia.; E, 1 in. dia.

and a washer. One spoke of the former of this coil is made slightly longer to take two screws, so that the coil can easily be connected to the circuit. The reaction coil is mounted a knob and dial is screwed to the end which projects through the panel. The position of the reaction coil with respect to the aerial coil may be adjusted by turning this knob.

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The distance between the panel and the back of the reaction coil should not exceed $\frac{7}{8}$ in. A suitable stop for the reaction coil

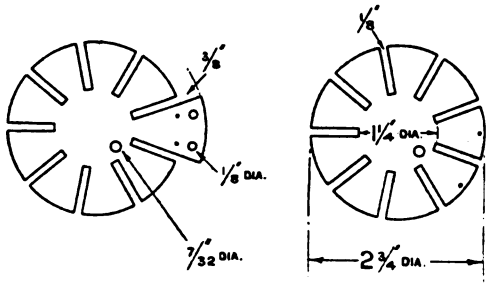

Fig. 2. On the left the former of the aerial coil, and on the right the former of the reaction coil.

can be arranged by soldering a piece of strip brass to the 2 BA rod. This brass strip is stopped by the screw that secures the aerial coil, and another screw can be put through the panel under the dial to form the other stop. The brass strip is between the panel and the aerial coil.

The components required are as follows:

2 D.E.3 valves.
2 Burndept anti-phonic valve holders.

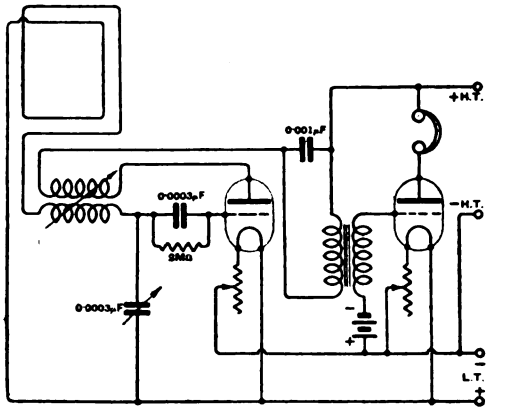

Fig. 4. Theoretical diagram of the receiver.

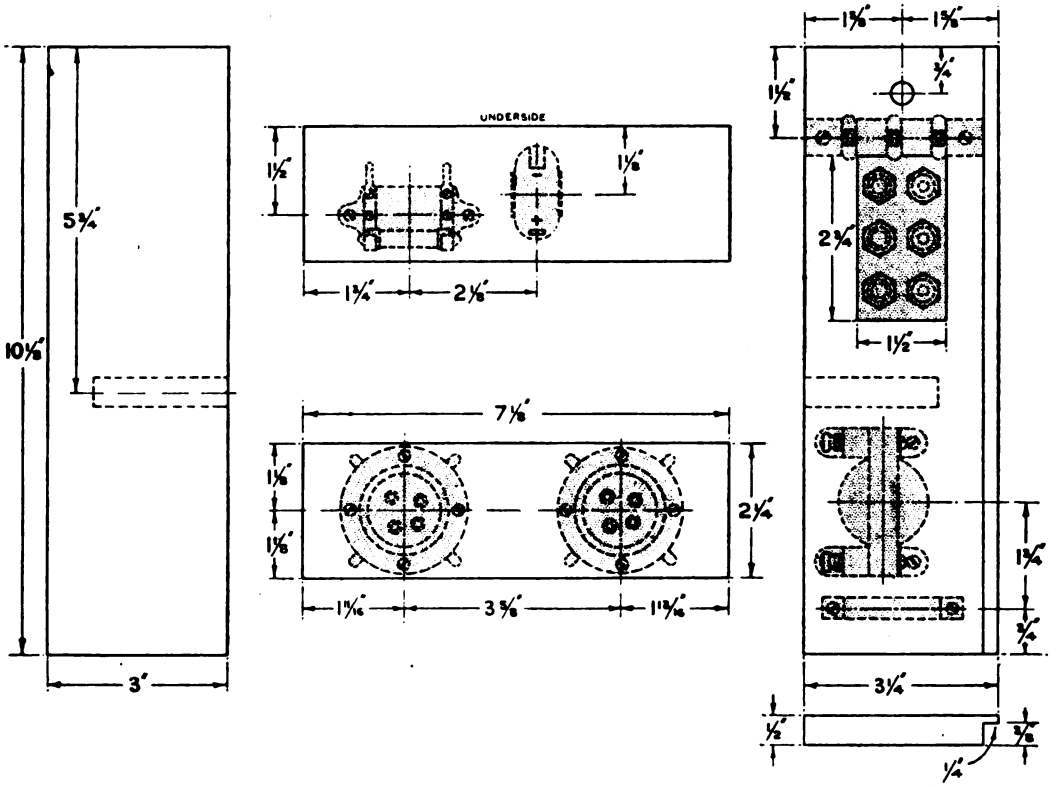

Fig. 3. Details of valve platform and supports. The platform is screwed to the supports at the position indicated by dotted lines. See Fig. 6.

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2 Burndept 30-ohm filament resistances.
2 Valve windows.
1 0·0003 μF Ormond variable condenser.
1 0·0003 μF Dubilier condenser with clips and 2-megohm grid leak.
1 0·001 μF, 600 A type Dubilier condenser.
1 Royal L.F. transformer.
1 Ever-Ready dry cell battery (3 volts) for grid bias.
3 15-volt H.T. batteries.
1 Ever-Ready dry battery, type L.T.3.

prise the two filament resistances, the valve windows, the variable condenser, and, of course, the reaction and aerial coils. The position of the parts may be seen by referring to the photograph at the head of this article. Construct next the supports for the ebonite panel, and mount the necessary components on them, as indicated in Figs. 3 and 6. The grid battery is secured by a piece of strip brass which is screwed to the valve platform. The valve platform is

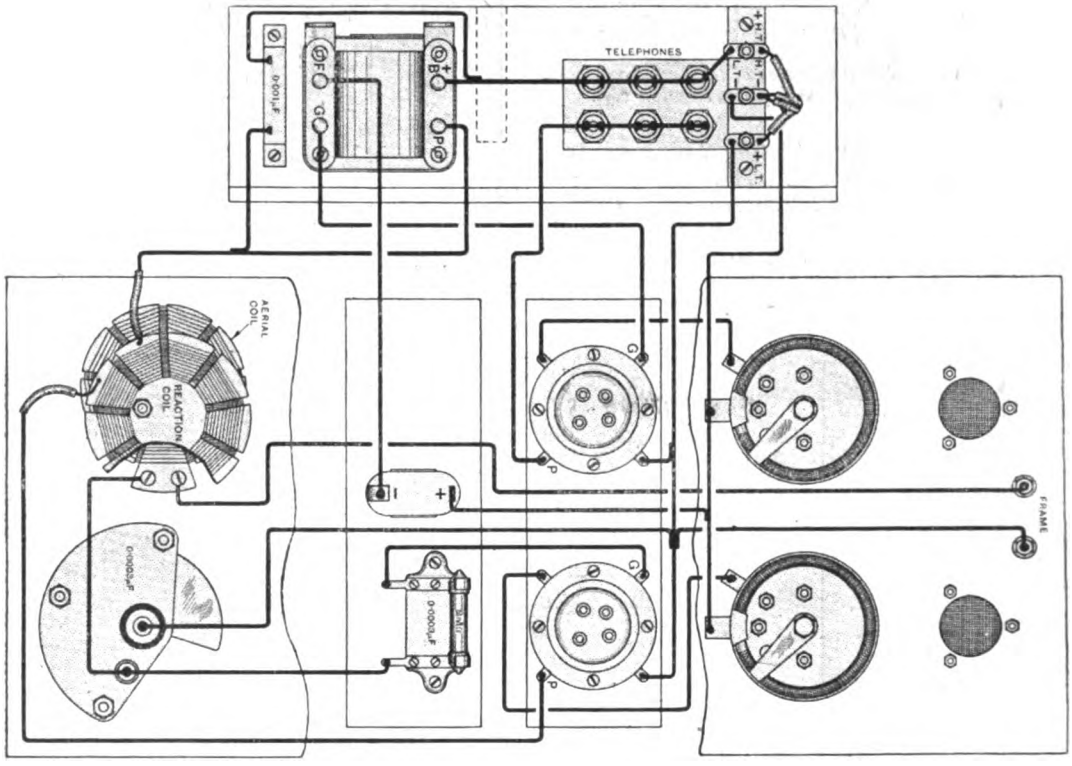

Fig. 5. Wiring diagram.

3 pairs of Sterling telephone sockets and plugs.
$\frac{1}{4}$ lb. No. 20 tinned copper wire.
15 yards of 2 mm. flex.
2 ft. of brass strip.
1 piece of mahogany 1 ft. 6 ins. by 8ins., by $\frac{1}{2}$ in.
Various wood screws, and a small quantity of No. 28 and No. 36 D.C.C. wire.

Next mount the components that are housed on the ebonite panel. These com-

screwed to the side of the supports by four 1-in. wood screws. On one of the wooden supports the telephone sockets are mounted. The sockets themselves may be secured upon a piece of ebonite $3\frac{1}{2}$ ins. by $1\frac{1}{2}$ ins. by $\frac{1}{4}$ in., being spaced $\frac{7}{8}$ in. apart, and the pins arranged $\frac{3}{4}$ in. apart.

The ebonite strip upon which the flexible leads from the batteries are soldered is next constructed. The strip consists of a piece of ebonite 3 ins. by $\frac{5}{8}$ in. by $\frac{1}{4}$ in., upon which is screwed three small pieces of brass to form

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connecting tags, the whole being secured by two screws. It will be noticed that the hole through which the flexible leads pass has an ebonite bush. This bush was the ebonite portion of a wander plug. If the flex is obtained in four different colours it will greatly facilitate the wiring to the batteries as it is somewhat difficult to trace the wires through the ebonite bush.

The frame aerial, which is mounted in the lid, consists of 14 turns of flexible wire wound upon wood strips $\frac{1}{2}$ in. wide by $\frac{1}{4}$ in. thick. Holes are bored with an $\frac{1}{8}$th in. drill through the thickness of the strips and are spaced $\frac{1}{4}$ in. The strips are secured by screws upon a thin piece of three-ply wood $15\frac{1}{2}$ ins. by $8\frac{1}{2}$ ins. The ends of the frame aerial are passed through the wood at the

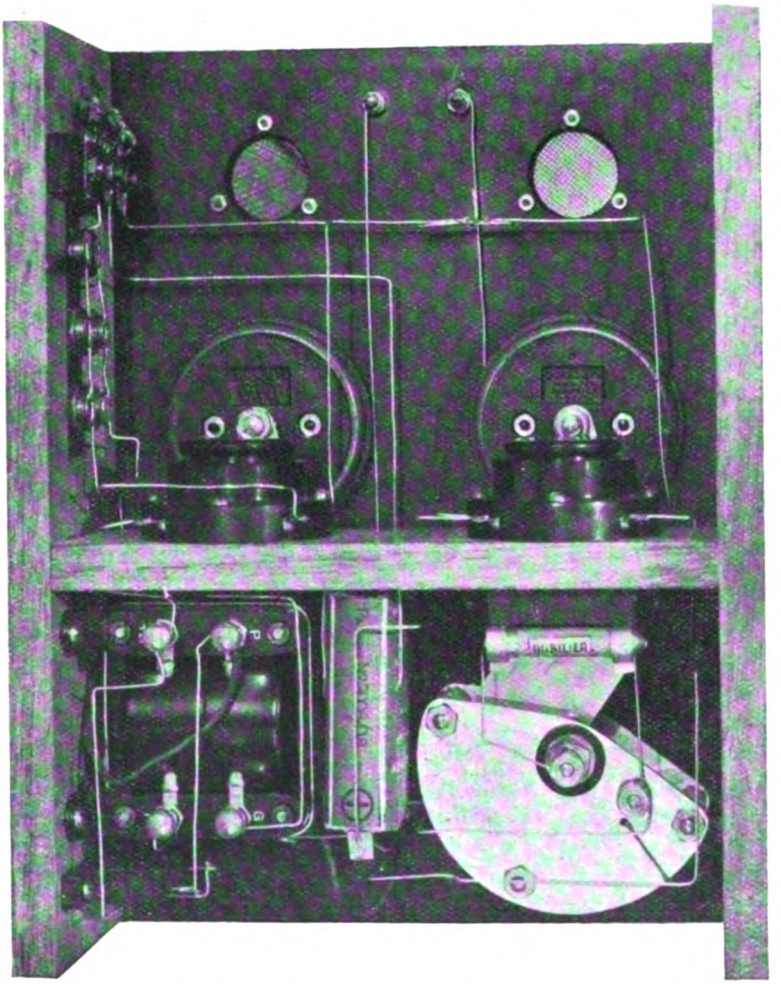

Fig. 6. View of the back of the panel showing the valve platform and supports. The aerial and reaction coils are between the panel and the L.F. transformer.

The receiver is now ready for wiring. This can easily be done if the wiring of the panel is completed before the panel is screwed down. Flexible wire must of course be used for the connections from the reaction coil. The wiring diagram is Fig. 5.

position opposite the frame aerial terminals. To hold the frame in position, a 2 BA screw is passed through the lid of the case, and a nut screwed on.

From the general lay-out, Fig. 7, the reader will see the position of the batteries.

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A piece of strip brass $\frac{3}{8}$ in. by 1/16 in. is used to secure these batteries to the case.

When the receiver is finished it may be found that the wires from the reaction coil have to be reversed, and that better signal strength is obtained by spacing the reaction coil a little further from the aerial coil. These adjustments are easily made.

It is also advisable to try the valves (of the D.E.3 type) in different positions as one valve may operate much better as a detector than another.

The frame should, of course, be pointed in the direction of the transmitting station so far as possible, if maximum signal strength is required.

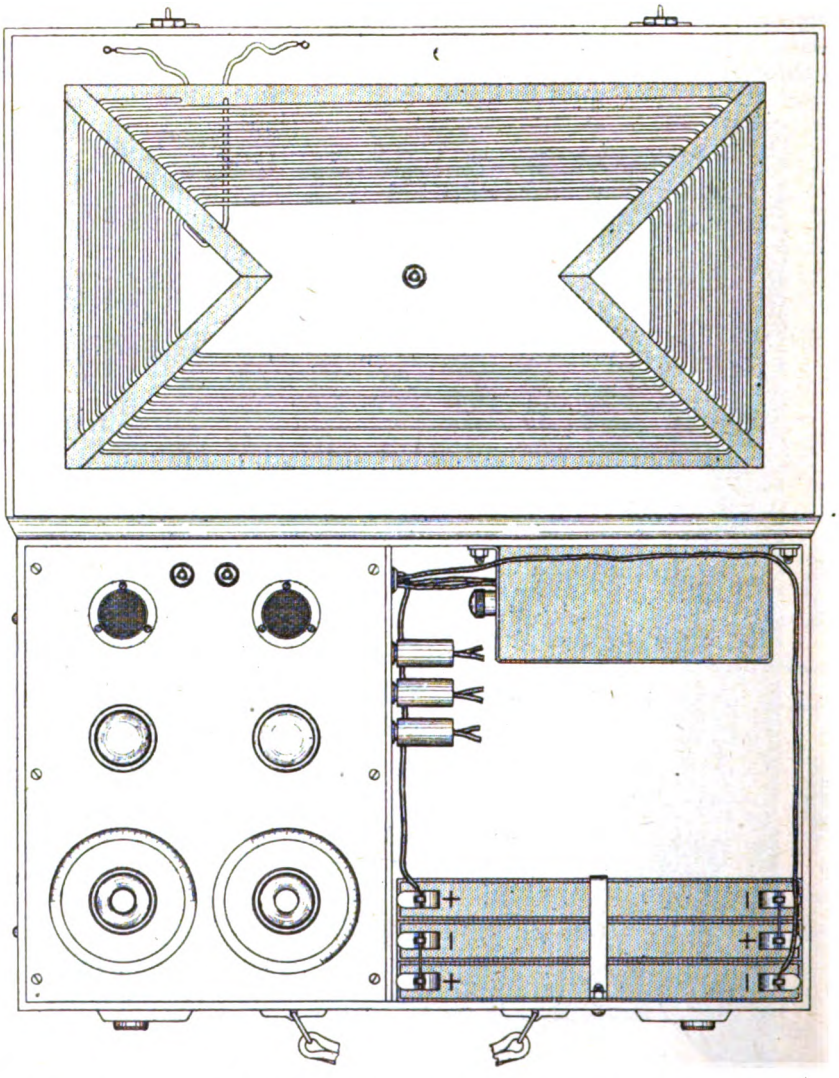

Fig. 7. General arrangement of the receiver in the attaché case. To show the frame aerial clearly, it is drawn reversed.

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THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

The Super-Heterodyne Receiver.

IT is an easy matter to employ effectively several stages of high frequency amplification to strengthen signals of long wavelength, and very difficult to amplify signals of short wavelength. The difficulty with short wavelength amplifiers is to secure a reasonable degree of amplification and selectivity with stability and ease of operation. Usually it is found necessary to employ sharply tuned circuits if the set is to be effective, but when the circuits are tuned to the incoming signal, the amplifier oscillates. Hence we find, even for the broadcast wavelengths, that more than two stages of tuned high-frequency amplification are rarely employed, and even then the amplifier is "neutrodyned," or very specially designed and constructed. The instability and ineffectiveness is due chiefly to the capacity between the circuits and the elements of the valve. Of course, these capacities are present, whether the amplifier is designed for short or long wavelength amplification, but they become more important as the wavelength is reduced.

The super-heterodyne or supersonic receiver is primarily an instrument designed to change the incoming short wavelength signals into long wavelength signals, so that they may be strengthened effectively by a long wavelength amplifier. With the super-heterodyne receiver, therefore, we are able to amplify the signals to a much greater extent than would be possible if the original signal was applied to a short wavelength amplifier, and further, we can secure the desired degree of amplification with relative ease, as long wavelength amplifiers can be made stable and do not require sharply tuned circuits.

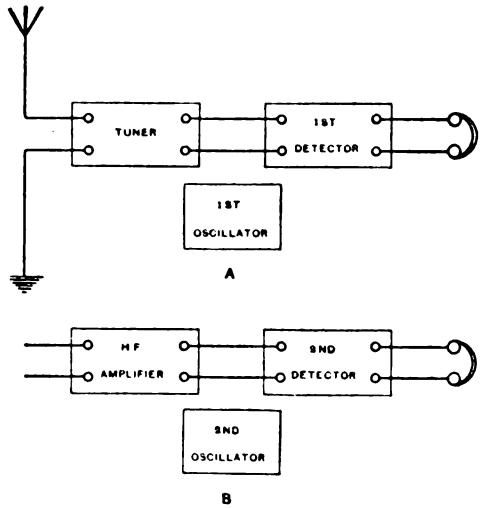

Fig. 1. A. The first portion of a super-heterodyne receiver.
B. The second portion of the receiver.

The high degree of amplification obtainable with a super-heterodyne receiver is only one of several advantages to be derived from its employment. Extraordinarily good

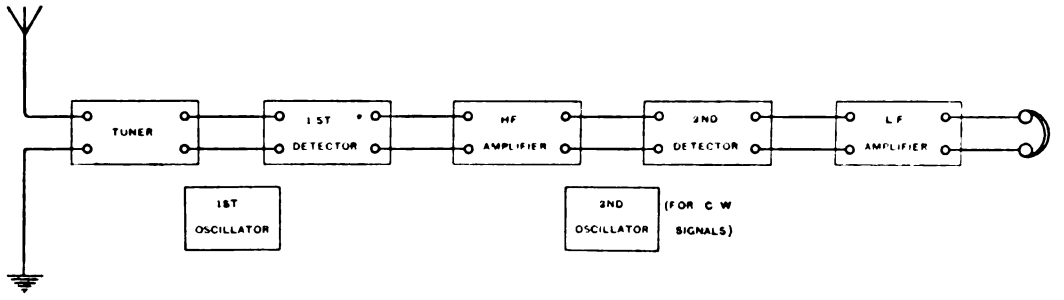

Fig. 2. Schematic arrangement of a super-heterodyne receiver, combining Figs. 1 A and B.

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selectivity is automatically secured, as will be shown later.

The Principle of the Super-Heterodyne Receiver.

The principle of the super-heterodyne receiver may be understood with the aid of the schematic diagrams of Figs. 1 and 2, and the curves of Figs. 3 and 4. From Fig. 1A it will be seen that the aerial is connected to a tuner, which in turn is joined to a detector, and if the incoming oscillations are telephone signals, the speech will be heard in the telephones connected in the anode circuit. So far, therefore, we have an ordinary tuner and detector.

To receive continuous wave signals, however, it is necessary to set up oscillations to beat with the incoming signal. The desired result may of course be obtained by employing a reaction coil coupled to the tuner, but a better method consists in using a separate oscillator. The frequency of the oscillator is adjusted to be a few hundred, or perhaps a thousand cycles lower or higher than the frequency of the incoming signal. If the C.W. signal has a frequency, for instance, of 1,000,000 cycles (300 metres), the oscillator would be adjusted to a frequency of about 1,001,000 (or 999,000) cycles, producing a note having a frequency of 1,000 in the telephones. If the oscillator was adjusted to a frequency of 1,000,500 cycles, the note in the telephones would have a frequency of 500 cycles; if the frequency were 1,010,000 cycles, a current of 10,000 cycles would flow through the telephones.

A note of 500 or 1,000 cycles is comfortably audible, but few people would hear a note of 10,000 cycles. By setting the oscillator to a frequency of, say, 1,020,000 cycles, the frequency of the current passing through the telephones would be 20,000 cycles, which would not produce an audible note.

The effect of altering the frequency of the local oscillation will probably have been noticed by those who allow their receivers to oscillate when receiving telephony. The circuits may be so adjusted that the locally generated oscillations have the same frequency as the incoming signal. No beat note is then heard. As the tuning of the receiver is changed, however, a beat note is produced which may be varied in pitch from a low to a high value until the beats become so high that they are inaudible.

The operation will more readily be understood by referring to Fig. 3. Curve A represents an incoming C.W. signal of 1,000,000 cycles (300 metres), which is

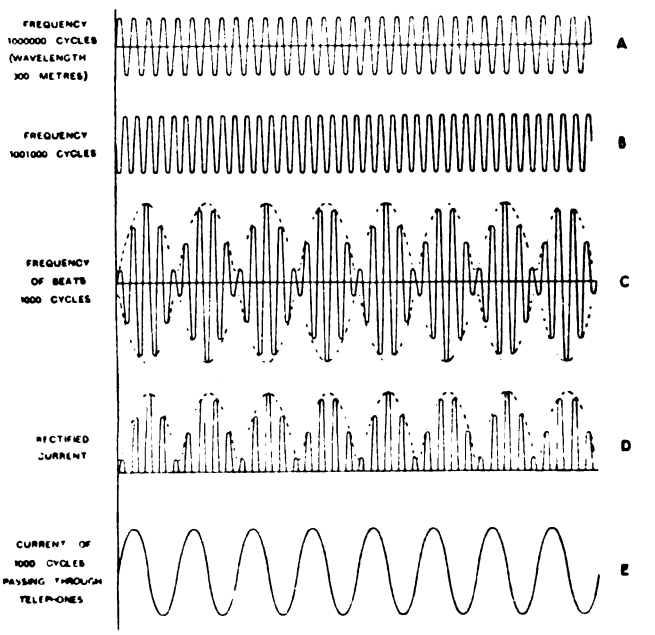

Fig. 3. Curves explaining the operation of the first portion (Fig. 1A) of a super-heterodyne receiver.

flowing in the oscillatory circuits of the tuner, and curve B represents the locally generated oscillations having a frequency of 1,001,000 cycles. These two oscillations—assisting one another when they are in step or in phase, and opposing one another when they are 180 degrees out of phase—produce oscillations which vary in amplitude as in curve C, the frequency of the beats being the difference between the frequencies of the two oscillations, in this instance 1,000 cycles. The currents flowing in the anode circuit of the detector are therefore of the form indicated in curve D. A condenser is usually provided to carry the high-frequency com-

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ponent of the rectified current to the filaments of the detector, and the low frequency component passes through the telephones, producing a note of 1,000 cycles.

It is important that the reader should understand that the beats may be given any frequency, so that instead of the currents represented by curve E, Fig. 2, producing an audible note, their frequency may be so high that they will oscillate in an ordinary tuned circuit adjusted to resonance.

The relative strength of the locally generated oscillations to that of the incoming signal and various other factors affecting the operation of the receiver need not be considered for the time being.

The High Frequency Amplifier.

Now that we understand that by suitably adjusting the frequency of the local oscillator beats of almost any frequency may be set up in the detector circuit, it is not difficult to realise that if a circuit tuned to the frequency of the beats is connected to the anode circuit of the detector, oscillating currents of the beat frequency will flow. These may be applied to an amplifier, as indicated in Fig. 1B, and strengthened to the desired extent. The amplifier should be one designed to amplify oscillations of the beat frequency. For instance, the beat frequency in a practical case may be 60,000 cycles, corresponding to a wavelength of 5,000 metres.

Having amplified the signals to the desired extent, it is necessary to heterodyne them and to rectify them in order that they may be heard in the telephones. We therefore connect the H.F. amplifier to a detector, and couple an oscillator to the circuit of the detector as indicated in Fig. 1B. The reason for the second detector and oscillator will readily be understood if the oscillations flowing in the H.F. amplifier are considered as being long-wavelength C.W. signals. As to the frequency of the second oscillator, this should be adjusted to be, say, 1,000 cycles above or below the frequency of the oscillations in the H.F. amplifier—in this instance 61,000 or 59,000 cycles. Then a beat note of 1,000 cycles will be heard in the telephones.

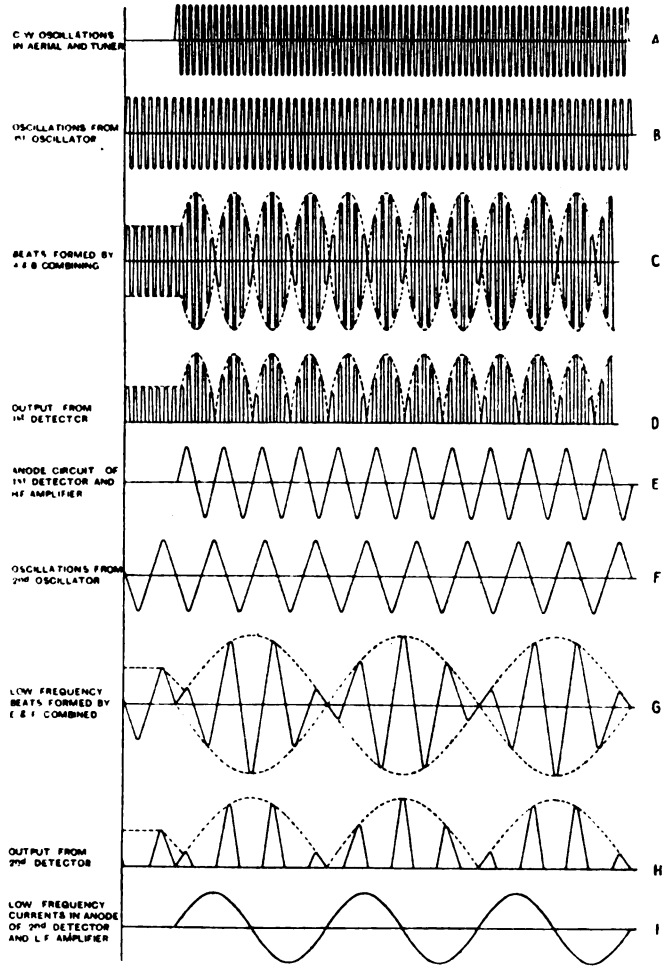

Fig. 4. Curves explaining the operation of a complete super-heterodyne receiver.

By combining Figs. 1A and 1B, we obtain the layout of Fig. 2, which represents a complete super-heterodyne receiver arranged for the reception of C.W. signals. The second oscillator (as will be explained later) is not required when receiving modulated signals such as telephony.

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The operation of a super-heterodyne receiver for the reception of C.W. signals is fully explained by the curves of Fig. 4. We have first the low wavelength oscillations flowing in the aerial circuit. These are received by the tuner (Fig. 2), and are represented by curve A. The first oscillator is coupled to the tuner, and delivers oscillations of a different frequency as represented by curve B. Thus beats are formed, passed to the H.F. amplifier as indicated by curve E. These are strengthened by the amplifier, and are applied to the second detector. At the second detector we have the oscillations which were amplified by the H.F. amplifier and the oscillations set up by the second oscillator. (The oscillations from the second oscillator are represented by curve F.) These oscillations form beats of audible frequency as indicated by curve G,

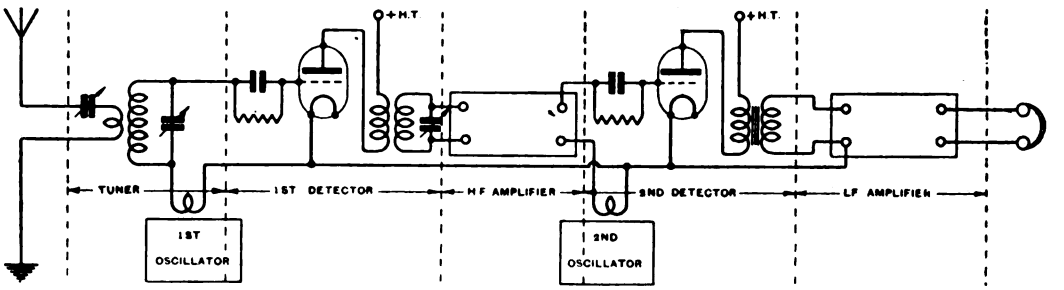

Fig. 5. The schematic arrangement of the super-heterodyne receiver of Fig. 2, but showing essential components.

curve C, the frequency of the beats being determined by the difference between the frequency of the incoming C.W. signal and that of the oscillator. The beats are rectified by the detector, so that we have oscillations of the form of curve D in the anode circuit of the detector. As the anode circuit of the detector contains a circuit which is tuned to the frequency of the beats, currents of the beat frequency flow in this circuit and are which are rectified by the detector as at H. The low frequency currents I are then heard by connecting telephones to the detector, or a low-frequency amplifier, as in Fig. 2, may, of course, be employed between the second detector and the telephones.

The diagram of Fig. 5 shows the essentials of the super-heterodyne receiver, which will be fully described in the next number of this journal.

BOOK REVIEW.

The Book of the Wireless Valve. (The Mullard Radio Valve Co., Ltd., pp. 71. Price 1/6.)

This little volume provides interesting reading to all wireless men, even though they may use valves other than those manufactured by the publishers. It opens with a short historical note on the evolution of the valve, the second chapter giving a simple explanation of the elementary principles underlying its action.

Much of the good advice contained under the heading "Points of a Good Valve" cannot, unfortunately, be carried into effect owing to the present-day valves being more or less opaque.

A few simple notes on receiving circuits are next given, but it is a pity that the "jar" has been used as the unit of capacity. Most wireless men, outside the Services, are more conversant with the microfarad and therefore references to $\frac{1}{4}$ or $\frac{1}{3}$ jar do not convey much to them until converted into the more generally used unit.

The remainder of the book is taken up with a description of the several Mullard valves on the market, Receiving, Power, Rectifying and Transmitting, with useful notes on the various types. A number of photographs of typical valves and their characteristics completes the work.

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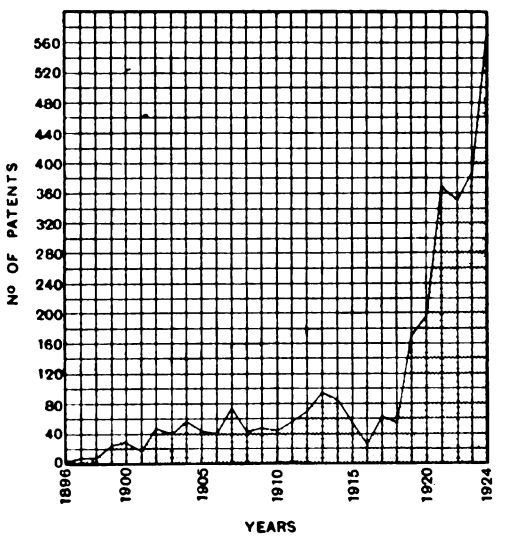
A RECORD OF BRITISH WIRELESS PATENTS.

IN a recent note in this journal, reference was made to the fact that since the introduction of broadcasting in this country, the number of patents taken out through the British Patent Office has increased to an enormous extent. The note was intended primarily to draw attention to the large number of worthless inventions reaching the Patent Office, due to ignorance on the part of applicants. It has since been pointed out to us in correspondence that it might have been explained also to our readers that it is incorrect to assume that the application for a provisional patent



constitutes a protection. The principal purpose of a provisional patent is to date an invention. An application for a patent is therefore of no value unless it is followed up by the complete specification and the patent is accepted and sealed at the Patent Office.

As a matter of interest, the chart illustrated here has been compiled, giving an indication of the number of patents granted between the years 1896 and 1924. Only those have been included which could be be regarded as of direct wireless interest. In the year 1896 only two patents were taken out and the number has steadily increased until the year 1919, when a very marked increase in the number of patents filed took place, but it was not until after the war that what can be described as a rush of applications for patents occurred.

Number of Patents Granted for Period 1896-1924 (November 30th).

1896	.. ..	2	1911	.. ..	57
1897	.. ..	8	1912	.. ..	69
1898	.. ..	8	1913	.. ..	93
1899	.. ..	23	1914	.. ..	85
1900	.. ..	29	1915	.. ..	55
1901	.. ..	19	1916	.. ..	27
1902	.. ..	46	1917	.. ..	61
1903	.. ..	40	1918	.. ..	55
1904	.. ..	58	1919	.. ..	169
1905	.. ..	42	1920	.. ..	193
1906	.. ..	40	1921	.. ..	368
1907	.. ..	75	1922	.. ..	351
1908	.. ..	42	1923	.. ..	386
1909	.. ..	49	1924	.. ..	564
1910	.. ..	44	(Up to November 30th)		

NOTE.—The increase during the years 1921 and 1922 is largely accounted for by the fact that many of these were filed under the Peace Treaty and claimed prior dates of application.

The war upset the records to a certain extent, because applications from abroad were largely held in abeyance during the years of the war and were subsequently granted in the years 1921 and 1922 under the Peace Treaty and prior dates of application were allowed in most cases. This accounts for the large number taken out in these two years 1921 and 1922, and if this fact is taken into consideration it only serves to emphasise the enormous increase in wireless patents since broadcasting commenced. Taking these figures as showing the number of completed patents, one realises how great must be the number of applications made which were never completed.

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WAVEMETERS.

By L. B. TURNER, M.A., M.I.E.E.

(*Continued from page 422 of previous issue.*)

DISCUSSION.

Mr. C. F. Phillips in opening the discussion said: I have been studying wavemeters of the sub-standard type for some considerable time so that I have been more than interested in the lecturer's very able description not only of the types of wavemeters that it is possible to use but of the various purposes for which they can be correctly adapted, because it is a most important thing not to use the wrong type of wavemeter for the job you have in hand. I noticed with some interest that the author spoke of enclosing his standards in wax. I expect he knows a great deal more about wax than I do and I expect that his standards have remained constant but I have enclosed things in wax and although I had thought that they would remain constant, after about three years I found the wax had cracked and had occasioned quite a difference in the capacity of an enclosed condenser. The author treated the oscillating valve wavemeter a little unmercifully, to my mind. He admitted that it was possibly the instrument of the greatest precision that we had in our laboratories and yet he seemed to say that it was not suitable for sub-standard work. By sub-standard, I mean an instrument that can be used with an error of say two or three parts in 10,000 for calibrating other instruments. I do not mean a sub-standard of the precision that might be necessary at the National Physical Laboratory. I believe that it is possible to construct valve wavemeters of a precision of two parts in 10,000, and venture to say that it is possible to maintain practically that accuracy if certain precautions be taken. The most important thing is to choose the proper type of valve; do not be tempted to use the modern valve in which the vacuum is obtained by the modern system known as "gettering"; for wavemeter purposes the electron emission must remain very constant and to attain this end it is essential that the valve be properly evacuated by the older methods. In order to get a valve that will last for many years, it is desirable that the filament be run well below its rated voltage, and in order that this may be done without impairing its qualities as an oscillator, it is desirable to select a valve which normally has a very high emission. These qualities are filled by a valve known as the "L.S.5" which, when run at 4·5 volts, has an emission of nearly 100 milliamperes; run at 3·2 volts it will oscillate freely and has an almost unlimited life; further, the construction is very rigid and very uniform in different specimens, this uniformity being due to the fact that the valve is primarily designed for Post Office telephone repeater stations, where exact conditions must be reproduced in all valves.

The grid condenser and leak have values of 0·00025 microfarads and 100,000 ohms respectively, and have the peculiar effect of making the oscillating frequency practically independent of emission changes within the valve, and further, of allowing valves to be changed without very materially affecting calibration accuracy, provided one type of valve be adhered to. This effect is very fully explained by Professor Morecroft*, so I will not labour the point. If an accuracy of the order of two parts in 10,000 is to be maintained, it is necessary, every time the wavemeter is used, to reproduce the conditions of calibration; Fig. 1 shows three measuring instruments inserted in the circuit to that end. "A" is a filament voltmeter which allows one to adjust the filament to exactly 3·2 volts (if so calibrated) every time the instrument

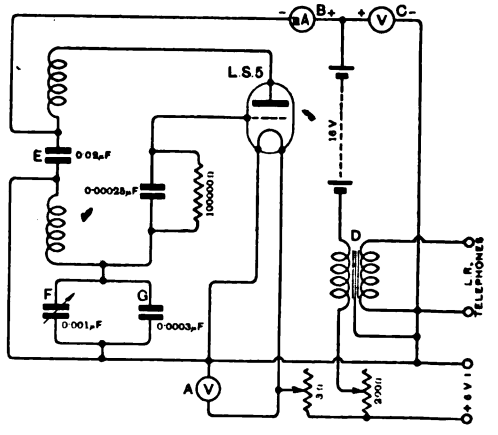

Fig. 1. Connections of the heterodyne wavemeter described by Mr. Phillips.

is used. "B" is a 1·5 milliamperemeter which is in the plate lead and allows one to check the emission; this must always be done at a constant setting of the main tuning condenser, say at maximum value. The next thing is to adjust the voltage of the plate supply. I use a 16-volt plate battery connected to a potentiometer across the filament battery, thus giving an adjustable voltage between 16 and 22, which is always indicated by the 24-volt meter marked "C" in the diagram. A word of warning about that voltmeter. It is useless to use the usual pattern taking about 18 milliamperes at full scale, as that would rapidly exhaust the 16-volt battery, but it is easy to obtain a special meter with a galvanometer movement taking 1·3 milliamperes only. Both voltmeters "A" and "C" must be permanently in circuit, while the wavemeter is in use, as if switched off the reduction in load would increase the voltages.

* "Principles of Radio Communication," by J. H. Morecroft, 1921, page 795 *et seq.*

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"E" is quite a large condenser and "D" is a telephone transformer, preferably of the shielded pattern, with core and shield connected to L.T. —. Finally connect L.T. — to earth, and if possible shield the whole instrument with an earthed lining of thin copper. A last precaution is to put a *good* fixed condenser "G," 0·0003 μF, in parallel with the tuning condenser "F"; this ensures that no part of the calibration curve below a shunt capacity of 0·0003 shall be used, a condition which is very desirable for accurate work.

If a wavemeter be constructed in the way I have indicated, I believe that it is possible to have a wavemeter which will hold its calibration to two parts in 10,000 or thereabouts.

Mr. R. E. H. Carpenter.

The paper is so extraordinarily complete that it is very difficult to find anything useful to add to it, but there are one or two quite minor points which the author did not mention, although they are undoubtedly known to him, which it may not be entire waste of time to mention. He referred to the click method for determining when a standard LC circuit is in resonance with an oscillation generator. I have found in practice that a very much more convenient laboratory method than that consists in arranging an oscillator with a milliammeter in the anode circuit and a grid leak and condenser as shown in Mr. Phillips' diagram, and bringing a standard LC circuit up to it. If, then, you swing the variable L or C in either circuit, the milliammeter needle will kick at some adjustment and, by noting the point at which the anode current changes, you can assess quite readily—without having to go about with telephones on your head, which is often inconvenient—when these two circuits are in resonance. It is surprising how accurate a result you can get in this way, provided the coupling is made weak enough. There is a small practical point which I should like to mention in connection with buzzers. It is a common practice to use the wavemeter current to operate the buzzer; *i.e.*, that you have to choose the current which you put through your wavemeter sufficiently large to operate the magnet of the buzzer. I have found it more convenient to have a buzzer with two contacts. One of the contacts operates the buzzer as such—in my own case a tuned reed which gives much steadier results—and there is an entirely separate contact for the wavemeter. In that way you can control the current put through the wavemeter and cut down the sparking due to that current at this auxiliary contact quite readily without disturbing the mechanical operation of the buzzer reed. Furthermore, I make the hummer contacts of carbon; they act as a kind of microphone and the thing hums at an extraordinarily small current, about 4 milliamperes. A single dry cell will operate the hummer portion indefinitely and it hums extremely steadily. The buzzer contacts proper for the circuit are entirely separate and are metallic, to get a sharp break.

Mr. W. M. Holbeach.

I should like to ask if the author has tried to interrupt the oscillatory currents of a heterodyne wavemeter. Can the author suggest the best method of interrupting and which part of the circuit should be broken? The author also made some remarks about good and bad buzzers and what a lot of trouble they were to some people. I have heard of the Telefunken buzzer as being very good but it cannot be obtained now and I am wondering whether the author knows of a good one, a better one for instance, than the Ericsson. Regarding the Moullin voltmeter method, I take it that the voltmeter is put right across the LC circuit; does that take a lot of energy in the ordinary way and is it fairly sensitive?

Mr. F. L. Hogg.

May I ask Mr. Phillips a question with regard to his wavemeter which he says will give an accuracy of two parts in 10,000. The point arises in connection with the variable condenser. I remember discussing this question with some people who have had considerable experience in the manufacture of condensers and their opinion was that it is quite impossible to get a wavemeter—a sub-standard such as this—to be accurate within more than 0·1 per cent. for any period, say more than six months at a time, even if you expend something of the order of £20 or £30 on a condenser. I saw at the recent exhibition a large condenser with a wheel on top to adjust it, but I am told that even such condensers cannot be relied upon for an accuracy of more than 0·1 per cent. for anything more than two or three months at a time and I should be very glad if Mr. Phillips can tell us some way to get out of this difficulty because I am extremely anxious to possess a wavemeter of the accuracy he has mentioned.

Mr. C. F. Phillips.

I omitted to stress the fact that no wavemeter could be read more accurately than the tuning condenser could be set. Such special condensers are very expensive and usually have a worm-drive with micrometrical reading arrangements. I use a Bureau of Standards type, in which 1/16th in. movement corresponds to a capacity variation of 0·6 $\mu\mu$F; this permits a close estimation down to 0·12 $\mu\mu$F.

Mr. E. H. Robinson.

The lecturer has referred to the difficulty of getting the decrement of the buzzer side of the wavemeter low. I have had some experience in calibrating all sorts of wavemeters and I have noticed the same thing. Wavemeters, for some obscure reason, vary considerably. Several wavemeters of different well-known makes use the little buzzer which has been so extensively used in the Army. In one particular wavemeter the tuning of the buzzer appeared to be very sharp and I could never account for it. It was superior in this respect to many other buzzer wavemeters, such as the Townsend, and, judging by the sharpness of tuning, it appeared to be almost as good as an I.C.W. wavemeter. By heterodyning the buzzer oscillations on fairly long wavelengths, one obtained almost a tonic-train heterodyne note. I was rather surprised that a buzzer working at about 1,000 interruptions per second should permit such a low decrement.

I should like to ask the lecturer about a difficulty I have experienced when using heterodyne wavemeters, and that is the extraordinary variation of frequency with filament temperature on long wavelengths. This variation of frequency with

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emission is much worse on the longer wavelengths. On short wavelengths, say 300 metres, I have found it possible to plug in all sorts of valves and it does not make much difference to the pitch of the heterodyne note, but on 6,000 metres the wavemeter was practically useless unless you adopted every single one of the precautions to which Mr. Phillips has referred. I have my own idea of the reason for this but I should like to have the author's opinion.

Another point of interest is that many of us who are now trying to work on short wavelengths desire to calibrate our receivers or wavemeters down to 60 metres or lower. At the time we started this work there were very few standards available and I believe a number of experimenters in common with myself used the harmonics from broadcasting stations as standards for arriving at short wavelengths. The local broadcasting station produces strong enough harmonics down to the fourth, but when one wants to carry the tuning to about the tenth they become very attenuated indeed. I found a very convenient and simple way of getting these harmonics strongly down to about the thirteenth, and this is simply to take a crystal set and tune it to whatever the fundamental broadcast wavelength happens to be. If the crystal is rectifying properly, it has the effect of distorting the wave and introducing harmonics in a similar manner to that which the lecturer has mentioned as occurring in a valve oscillator operating under asymmetric conditions. Just get this crystal set tuned to the broadcast wavelength, and you find if you couple a much shorter wavelength receiver or wavemeter to the broadcast set you will hear very powerful harmonics right down to the thirteenth or fourteenth. This provides a very simple method of calibrating from high harmonics and in a few minutes you can calibrate a receiver right down to at least the fourteenth harmonic of the station you are using.

Mr. L. F. Fogarty.

There is only one point I should like to ask the author, but I am afraid that it may seem rather a silly one. He mentioned that he had prepared a standard of 50 metres by taking a suitable condenser and coil and casting them in wax. I was wondering what would happen, because although you can adjust the correct values of inductance and capacity before they go into the wax, they must alter materially afterwards.

Mr. G. G. Blake.

The author has referred to one of the early methods of calibration which rather interests me, and that was the method in which the nodes and loops are measured along two stretched wires, I believe (going back into history) General Ferrié at the Eiffel Tower, was probably one of the first to employ the method for measuring the wavelengths of a transmitting station. In 1901 he stretched a wire from the base of the Eiffel Tower, and by means of a hot wire ammeter, inserted near the Tower end of it, he adjusted its length until he obtained maximum readings in the ammeter. He was then able to trace the nodes and loops along the wire and tell what wavelength was being radiated.

Another thing in the lecture which interested me was that little contrivance for tuning up a station, which acts on the principle of a "wavetrap" on the absorption principle. I refer to the tuned circuit embedded in a block of wax which has already been mentioned several times in this discussion.

It is a very simple method of tuning. I do not think there is such a thing on the market. If one of our manufacturing firms could make up such a little tuned circuit and guarantee it to be reasonably accurate, it would, I am sure, prove a very useful commodity for the experimenter and it could be quite cheap. I hope this will be dealt with in the manner I have suggested.

Mr. P. R. Coursey.

If one may mention again the rather much discussed "block of wax," I should like to ask the author whether any correction was made for the temperature co-efficient of the articles inside that block, because both the inductance and certainly the condenser must change in value with the temperature, and unless the standard is used at one constant temperature, I do not know whether it would be of much value as a standard.

Mr. W. M. Holbeach.

I am wondering whether the author has noticed the apparent discrepancy between the wavelengths of B.B.C. stations as given out by the British Broadcasting Company, and those published by the National Physical Laboratory.

The President.

I should like to say that I was very glad Mr. Turner covered so wide a ground. He began with absolute measurement and went on to relative measurements. He evaded the controversy that always arises when absolute measurement is discussed, by not mentioning it, namely, we may measure either the period of a wave in absolute measure, in terms of mean solar seconds, or we may measure the length of the wave in terms of the standard metre or the standard foot. The method of harmonics—the multi-vibrateur or similar method, uses the second of time as the principal or fundamental unit. Another man may measure the wavelength by Lecher wires and he would use the standard metre as the fundamental unit. To pass from one measurement to the other we have to know the velocity of the waves perfectly accurately. If we do not we cannot translate kilo-cycles into metres or metres into kilo-cycles; therefore people using these two systems of measurement would arrive at the conclusion that the thing they had measured had two values very nearly alike, but not quite the same. This is because we do not know the velocity of the waves in each particular instance precisely enough. Another thing I was delighted to hear the author go into was the use of harmonics for calibrating wavemeters, for the reason principally that amateurs will now have to take up seriously the very short wavelengths of, say, 10 metres or 5 metres. This does seem possible, in the first place, because those who want to use 90 metres or 100 metres commercially will begin to drive the amateur off that range. That is one reason; that is the human reason. The other reason is that the 10-metre waves are probably going to prove better for amateurs than the 100 metres. It seems that as soon as the amateur is turned out of one territory into another he begins

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to demonstrate that he is in a better Eldorado than anybody anticipated. It seems that at 10 metres there will be no fading, no atmospheric disturbances,

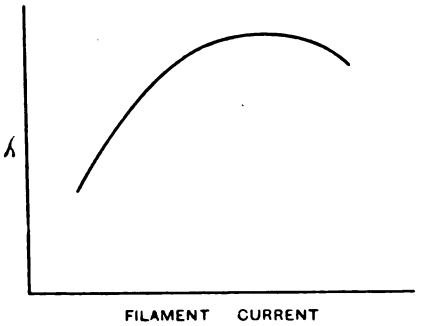

Fig. 2. A curve showing the variation of wavelength with filament current.

and that distances ranging to the Antipodes will be more easily covered than with 100 metres. Mr. Turner's suggestions of the use of harmonics for calibrating wavemeters are very appropriate at this juncture from that point of view. I should like to support the speaker who suggested that manufacturers ought to stock wavelengths; pieces of wire and sheets of copper fixed in some way that would not vary too much with temperature or with abuse and could be relied on to a reasonable degree of accuracy, and I hope the manufacturers will turn their attention to it. The other thing that has arisen during the discussion rather than during the paper is the degree of accuracy that a triode oscillator ought to achieve in the way of wavelength. I think you will find in a paper by Dr. Vincent and myself, read before the Royal Society in 1919, a description of how wavelength varies with filament current, *i.e.*, with emission, and with anode voltage. If we plot a curve with filament current as abscissae and wavelength as ordinates we get a curve like this (Fig. 2). If the coupling is not too close we always get a level part. If the filament current is kept at that level part, slight variations in filament voltage, through the running down of batteries, matter not at all and the variations in an ordinary battery are so slight that in practice it can run for an hour and the wavelength does not alter more than one part in 100,000, using an ordinary commercial triode. Moreover, if we measure the emission by putting a milliammeter in the plate circuit, we can substitute another triode, get the same emission, then vary the filament current until at the maximum point of the curve (Fig. 2), and correct the emission again; the wavelength will then be very nearly the same to a high order of accuracy. One can use this knowledge of the variation of wavelength with filament current and anode voltage to save the use of the numerous meters which Mr. Phillips introduced and which cost quite a considerable sum of money.

Mr. Turner, replying to the discussion, said:—

Mr. Phillips has spoken of the cracking of the wax of sealed condensers and coils, and several other people have referred to wax sealing. I am a firm believer in wax, and I think there is no need for a block of wax to crack. If you use the proper mixture it will not crack; moreover, any wax may be poured in successive small quantities, time for solidification being given after each pouring. I have sealed many pieces of apparatus in this way, using generally ordinary paraffin, and have found the process quite satisfactory. Mr. Phillips spoke of a triode oscillator of great accuracy and constancy, obtained by taking special precautions—elaborate precautions—to keep the triode in the same condition. These precautions are of the sort I had in mind when I said the thing is not, in my opinion, a convenient every-day instrument.

Mr. Carpenter spoke of a milliammeter placed in the anode circuit of the oscillator, to take the place of the telephone in what I called the "click" method of observing resonance. I have used it often myself and I like it very much. It is closely akin to the "click" method, and is sometimes very much more convenient; and I do not see why it should not be at least as sensitive. As to the buzzer with two contacts, I am not sure. It is very nice if you can get a good buzzer with two contacts but it seems to me rather a difficult instrument to provide.

It is a good thing in principle to separate the driving contact from the exciting contact, but I am not sure that I understand its advantage as a means of obtaining a very small current. Generally you want a fairly good current to get enough power—it is about 0·2 amps. in this wavemeter, for example. I am alive to the fact that I might have reduced this current in order to avoid sparking trouble; and I did reduce it experimentally, but I got no improvement in decrement. I suspect that if I had reduced it by 100 times I should not have got any better decrement. It seems to be a poor contact, not a spark phenomenon.

Mr. Carpenter.

The point rather is this, that if you have a wavemeter consisting of a condenser, with unchangeable currents but varying L's and varying R's also, you have the thing running quite satisfactorily on a small coil and you have certain battery power. You change the coil of the buzzer and you have to find more dry cells to correct the thing by, and then you change back again. If you keep the two functions separate, you use one dry cell only. You have one contact which you adjust for working the buzzer and the other thing is separated out. The two things being separate, it is much more convenient in practice. Also, if you have one contact, that contact must interrupt the current through the shunted L of your coil and there may be a greater tendency to spark.

Mr. Turner.

There may be a great advantage, and in principle it is right; but from some cursory experiments I have referred to, the trouble in this case seems not to be spark trouble. I should be glad if Mr. Carpenter could quote decrement figures obtained with his buzzer.

Mr. Holbeach asked about interrupting the currents of a heterodyne wavemeter to make the oscillations audible. He asked what is the best method. The best method is to have an acoustic

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valve oscillator and associate it with the H.F. oscillator in any way by which acoustic modulation of the H.F. amplitude is produced. If you use a buzzer, it does not matter where you put it, provided only that you do not excite the circuit under test by means of the buzzer directly. The buzzer must affect the oscillator and the oscillator must affect the circuit under test. There is such a variety of circuits that one must not generalise too carelessly, but I would put the buzzer in a place where it will not interrupt the anode current. I would let the buzzer short-circuit the reaction coil, or do something of that sort, rather than cut off the anode battery. The same speaker also asked what is the best buzzer. Years ago, when one was keenly interested in getting a good buzzer, I used to think of trying to design one; but I gave it up and lately I have not thought about it. I should say, however, that the type I have used here, the little tiny one which is so well known, is as good as any I have met. Then Mr. Holbeach asked about the Moullin voltmeter. It is really only a calibrated triode rectifier, working with negatived grid, and the current taken by it is negligible. The most important correction to be made for it is in regard to its capacity. You are adding another 10 micro-microfarads or so to the condenser across which you put it, and that may sometimes matter.

Mr. Hogg spoke about the difficulty of getting a good variable condenser. I sympathise with him very much. In this wavemeter I have avoided a variable condenser and have used a variable inductance instead. I do not think you can get a reliable variable condenser for precise measurements unless you are prepared to pay a large sum—not perhaps as much as he suggests, but £10 or more. The old Seibt condensers, now copied more or less by the Sterling people, I believe, were of beautiful workmanship and had a huge capacity for so small a space; but they are necessarily much upset by even very slight axial displacement because the air gap is so small. If you do not mind spending £10 or £20, and can allow bulk, you can get a thing whose calibration will be guaranteed, by a reputable maker, to stand constant to a fraction of one per cent. for a number of years.

Mr. Robinson spoke about heterodyning low-damped buzzer signals. That is an interesting point. A buzzer can be used in a practical way for receiving C.W. signals in the absence of a triode oscillator. It is quite a convenient thing to do. He also spoke of the use of a crystal for increasing the strength of high harmonics from a broadcasting station. It is an interesting suggestion, but I cannot offer any comment on it. I do not understand what was done. As the President has said, the measurement of very short waves is becoming more and more important, and any device such as Mr. Robinson has found satisfactory should be valuable.

Mr. Fogarty asked how I allow for the change of capacity of the various parts of the circuit due to the wax. What I do is to leave a little loop of wire standing up above the wax level, and bend it to make adjustments before giving the last dose of wax. It is not difficult to prepare a precisely adjusted sealed instrument in this way.

I thoroughly agree with Mr. Blake's suggestion that manufacturers should take up this question of selling wavelength standards and put on the market simple and cheap units for the purpose. As to constancy, I do not know that I can quote evidence; but I may point out that the best standard condensers one can buy are wax-sealed mica condensers.

Mr. Coursey suggested that the temperature coefficient of the articles embedded in the wax would cause trouble. I do not quite understand what he means. The articles have a temperature coefficient whether they are waxed or not, and the position is no worse in the wax than outside it. If you consider the actual temperature coefficient of any substance, such as copper, I do not think the change of dimensions due to change of ordinary temperatures is going to matter. It all depends on what accuracy you are working to; for half per cent. I do not think the temperature effect need be thought of.

Mr. Holbeach asked whether I would recommend him to take the wavelengths supplied by the B.B.C. or the N.P.L. as correct. Personally, I should have no hesitation in taking the N.P.L. figures. I was enquiring about the accuracy of the B.B.C. advertised wavelengths recently, and was told that, while they are very constant from day to day, they are distinctly inaccurate. For that reason I have not used them for calibration purposes. It would be a great convenience if the accurate wavelengths could be stated.

Mr. Reeves.

I have the pleasant task and the easy one of asking you to express our great appreciation of Mr. Turner's paper this evening. Like most of us here, I have made wavemeters of some sort or another for some time, but I have never so completely realised how essential it is to go for a higher degree of accuracy than I have hitherto done, particularly in view of the possibilities of shorter and shorter wavelengths being thrust upon us. I am sure therefore that the paper has come at a most opportune moment and I have very much pleasure in proposing that a very hearty vote of thanks be given to Mr. Turner for his paper.

Mr. C. F. Phillips.

It is a considerable pleasure to me to second this vote of thanks because it is a subject in which I have been interested for a considerable time and I do appreciate the very large amount of time which Mr. Turner must have given not only to the subject itself, but to the presentation of it to us this evening in such a very intelligible manner. When we have a scientist of Mr. Turner's standing coming to us and giving us a lecture upon so complicated a subject in such a simple manner, we must feel grateful to him. Very often one is apt to leave the lecture hall knowing little of what the lecturer has intended to convey and it is only later on, when one gets the printed paper, that a glimmering of what it is all about starts to dawn upon us. In this case, however, I think we have from Mr. Turner's lecture and diagrams learned as much as we shall learn later from the paper, through it being so particularly lucid. Therefore I will add my thanks to Mr. Reeves' and I have no doubt that you will be equally appreciative.

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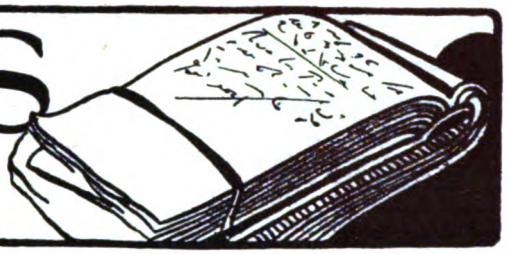
NOTES & NEWS



The proposed chess match by amateur wireless between the Universities of Oxford and Harvard has been prohibited by the Postmaster-General.

* * * *

The Argentine amateur, Mr. J. C. Braggio, DA 8 (ex CB 8), reports the reception of signals from G 5 NN (Mr. J. Ridley, of South Norwood), on November 23rd.

* * * *

It is proposed to install broadcast receivers in the State-owned public houses of Carlisle.

* * * *

CNRA, the new broadcasting station of the Canadian National Railways at Monckton, New Brunswick, has been received at Bangor, County Down.

* * * *

The reception of time signals from Annapolis, Panama, Santiago, Nauen and other stations, is proving of great assistance in control surveys now being conducted in the Mackenzie River District, Canada.

* * * *

A Presidential address will be given before the Radio Society of Great Britain on Wednesday, January 21st, when Sir Oliver Lodge, D.Sc., LL.D., F.R.S., will speak on "Matter and Radiation."

* * * *

AN IRISH WIRELESS EXHIBITION.

The first Irish wireless exhibition to be held on a large scale, is to take place in Dublin, we understand, from February 23rd to 28th. Ample space will be provided both for amateur and commercial

Reproduced by courtesy of *Radio Electricite.*

A recent photograph of the famous American inventor, Dr. Lee de Forest, who is seen operating a telephony transmitter on board the s.s. "Paris."

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displays, and it is expected that a prominent exhibit will be furnished by the Radio Association of Ireland.

AMBITIOUS PRIVATE RADIO STATION.

The Island of Anticosti, in the mouth of the St. Lawrence River, Canada, is being fitted with a wireless station under novel circumstances. The island, which is British, is wholly owned by M. Gaston Menier, the French chocolate manufacturer, whose object in installing wireless is to be able to "rule" his possession from his chateau in France.

DX WITH THE FAR EAST.

What is believed to be the first amateur two-way communication between England and Mesopotamia was established on Monday, December 8th, by Mr. J. H. D. Ridley (G 5 NN) and an amateur at Mosul, Iraq. The wavelength employed was 97 metres. 5 NN worked with an input power of 90 watts, while the Mosul amateur used 250 watts D.C. Communication was maintained for 2½ hours, a detector valve only being used at Mosul, whilst 5 NN employed a detector and note magnifier. The signal strength in both cases was in the neighbourhood of R 8, though the signals from Mosul were sometimes as strong as R 10.

As we go to press a report of similar communication with Mosul reaches us from Mr. E. J. Simmonds (2 OD) of Gerrard's Cross, Bucks.

FRENCH AMATEUR'S DAYLIGHT TRANSMISSIONS.

Remarkable results of tests with America on wavelengths between 35 and 48 metres are reported by M. Léon Deloy (8 AB), of Nice. The aim of these experimental transmissions was successful daylight communication, and recently M. Deloy's signals were heard in Hartford, Conn., at 1 p.m. (E.S.T.). The power used on this occasion at 8 AB was in the neighbourhood of 500 watts, a wavelength of 35 metres being employed. M. Deloy states that seven-tenths of the distance covered was in daylight, and claims that a record is thus set up for transatlantic amateur communication.

A MULLARD ANNIVERSARY.

On Tuesday, December 16th, the original male staff of the Mullard Radio Valve Co., Ltd., were entertained by the directorate to commemorate the fourth anniversary of their united efforts. During a pleasant evening's entertainment appropriate remarks were made by the managing director, Mr. S. R. Mullard, M.B.E., A.M.I.E.E., and Mr. C. F. Elwell, director, on the remarkable progress made by the company since its inception in 1920.

SUCCESSFUL DX WITH FINLAND.

Another British transmitter to effect two-way communication with Finland is Mr. G. L. Morrow (6 UV), of Berkhamsted, Herts, who successfully worked with Finnish 2 NCA, at 10.30 p.m. (G.M.T.) on December 13th. The operator of the Finnish station, Mr. Kairenius, of Helsinki, reported Mr. Morrow's signals as R 6 to R 7 on a single valve receiver, and communication was maintained for nearly an hour. 6 UV's transmitter made use of the conventional reversed feed back circuit, the oscillator being an L.S. valve supplied with 300 volts D.C. During the communication referred to, which took place on 115 metres, the aerial ammeter at 6 UV recorded 0.40 of an ampere.

CHILEAN AMATEUR DESIRES TESTS.

Mr. Edmundo Guerara, of Casilla 69, Vilcun, Chili, would be glad to arrange communication tests on short wavelengths with British amateurs. Mr. Guerara, whose call sign in CHEG, is carrying out improvements in his short wave transmitter, and would welcome transmission schedules from British amateurs who may be interested.

MARCONI D.E. 5 VALVE AS TRANSMITTER.

An interesting "low power" transmission to America was effected by Mr. D. B. Knock (6XG) on December 16th, when he established two-way communication with the American 1 BHM, using as "transmitting" valve a Marconi D.E.5. Good signals were reported by 1 BHM, and messages were exchanged on 102 metres. Unfortunately soon after contact had been established Mr. Knock's 12-volt accumulator supplying current to the M.L. anode converter began to run down, and communication was cut short. The actual input at 6 XG was 10 watts, with a plate voltage of 500, yielding an aerial ammeter reading of 0.4 of an ampere.

THE WIRELESS ANNUAL.

So many and extensive are the ramifications of wireless to-day that the amateur frequently finds it difficult to keep in touch with all branches of this ever-growing science. The need of a handy and informative reference book is supplied in the shape of "The Wireless Annual for Amateurs and Experimenters for 1925."* This book is valuable to the wireless enthusiast for the vast amount of useful data which it contains, but its value is still more enhanced by numerous articles on important subjects by writers of repute.

Among these is a fascinating contribution by Senatore Marconi, entitled "My Laboratories Ashore and Afloat," in which an historical account is given of the famous inventor's researches from his early experiments at Bologna, Italy, to the recent investigations on board the "Elettra."

Another absorbing article, by Dr. A. J. Fleming, F.R.S., deals with the early days of wireless research. Among the articles dealing with the latest developments of the science are "Broadcasting Microphones," by Captain H. J. Round, M.I.E.E., "The B.B.C. High Power Station," by Captain P. P. Eckersley, M.I.E.E., "Progress of Broadcasting in 1924," by Lord Gainford, "Time Signals," by W. G. W. Mitchell, B.Sc., and "Directional Aerials," by R. Keen, B.Eng. Other contributions of general interest include "Characteristic Valve Curves," by W. Sidney Barrell, explaining the basic principles of valve curve plotting, "Telephone Transmitters," by W. James, and a description, by Captain A. G. D. West, of the methods employed in special broadcast transmissions. Amateur progress

*Published by the Wireless Press, Ltd., 12-13, Henrietta Street, London, W.C.2, pp. 192 + lvii. With 8 illustrations. Price 2s. 6d. nett. Postage 4d.

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in 1924 is reviewed in an article from the pen of Mr. Hugh S. Pocock.

The reference section of the volume contains a fund of information relating to licence regulations, experimental transmitting stations in Great Britain and France, regular wireless transmissions, calibration waves, and useful data concerning components, radio symbols, and inductance and capacity calculations. Not the least useful section is the directory of manufacturers, and all amateurs and experimenters will derive benefit from the wireless atlas of the world, with which the volume concludes.

A QUESTION OF IDENTITY.

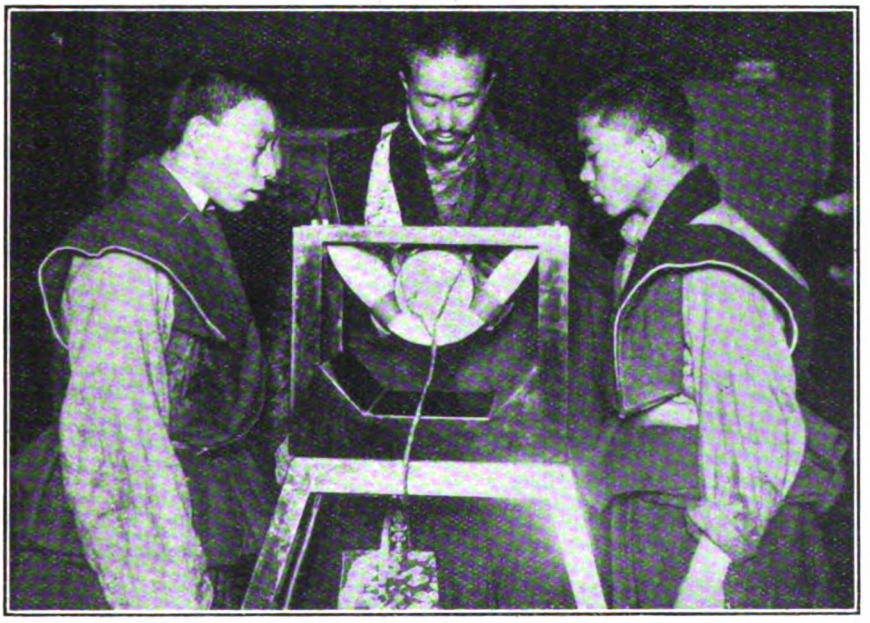
We regret that in the caption under the photograph appearing on page 179 of our issue of November 5th, which included portraits of Captain P. P. Eckersley and Mr. Arthur Lynch, a mistake occurred regarding the identity of the third member of the group. This gentleman is Mr. C. P. Edwards, Director of the Radiotelegraph Branch of the Department of Marine and Fisheries at Ottawa.

RUNBAKEN MAGNETO CO., LTD.

We have been advised that the Motor Accessories, Repairs and Spares, Ltd., has been formed to take over all the assets of the Runbaken Magneto Co., Ltd. The whole staff at the company's depots has either been retained or increased, and an improved service is assured for the supply of spare parts for magnetos, dynamos and batteries. The address of M.A.R.S., Ltd., is Ashburton Road, Trafford Park, Manchester.

RADIO COMPASS FOR U.S. AIRMEN.

A successful attempt at straight flight in a fog with the aid of a radio compass has been carried out by the U.S. Army Air Service and Signal Corps. The pilot, Lieutenant George W. Goddard, chose a hazy day for the experiment, and decided to fly in the airway between Dayton, Ohio, and Moundsville, W. Virginia. Guided entirely by signals from the Radio towers at Dayton and Moundsville, he was able to fly in virtually a straight line. When he was on the straight course only dashes were transmitted from the two stations. On deviating to the left, however, the pilot was warned by a dash and a dot repeated at intervals of 10 seconds; similarly a dot and dash signal warned him of a deviation to the right.



A number of Tibetan priests recently broadcast their native music from 2 LO. *The photograph depicts three of the party investigating the mysteries of the microphone.*

BOOKS, ETC., RECEIVED.

Measuring and Testing Instruments. Technical Pamphlet for Workmen, issued by Post Office Engineering Department (London: H.M. Stationery Office, Adastral House, Kingsway. W.C.2. pp.24 + x. Price 6d. net.)

Burndept Bulletin. Vol. I, No. 1. A little publication for radio enthusiasts. (London: Burndept, Ltd., Aldine House, Bedford Street, Strand, W.C.2.)

Recommendations for Regulations of Radio adopted by third U.S. National Radio Conference, October 6th to 10th, 1924. (Washington: Government Printing Office. Price 5 cents.)

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AMONG THE SOCIETIES.

Several papers of interest have recently been given before the Sunderland Wireless and Scientific Society. The subjects covered have included "Condensers—Fixed and Variable," by Mr. Aldridge; "The Electron," by Mr. L. L. Ruderman, B.Sc.; and "An International Language for Radio," by Mr. Fairburn, of the Esperanto League. The Society has now been allotted a transmitting licence with the call sign 2 SN, and constructional work on the new transmitter is being actively proceeded with.

* * * *

In consequence of a considerable number of complaints of broadcast interference in the district, members of the Dulwich and District Wireless and Experimental Association recently carried out some interesting D.F. tests with two mobile stations. Frame aerials were employed, and a number of bearings were taken. The results of these investigations are not at present available.

* * * *

The first wireless exhibition in North Wales was recently held at Wrexham with great success under the auspices of the Wrexham and District Wireless Society. The attendance was unexpectedly large and fully justified the efforts of the manufacturers and amateurs who provided exhibits of apparatus and accessories. A feature of the event was the demonstration of loud speaker reception on a receiver constructed by a member of the Society. A number of interesting competitions were arranged, and prizewinners included Mr. R. N. Edwards, for the best crystal set, Mr. G. Eastwood, for a single-valve receiver, and Messrs. W. S. Featherstonehaugh, and C. Cathrall for multi-valve sets.

* * * *

The language difficulty in radio, and a guide to its solution, formed the subject of a lecture by Mr. Harold Bell before the Hackney and District Radio Society on December 15th. The lecturer dealt with some surprising facts concerning the growth of Esperanto, and referred to the large number of continental broadcasting stations which now transmit programmes and talks in this artificial tongue.

* * * *

On Friday, November 14th, an interesting paper on "Inductance and Capacity" was given by Mr. H. R. Prescott, A.R.S.M., B.Sc. (member), before the Radio Section of the West Bromwich Engineering Society. The paper was accompanied by a large number of practical experiments.

On Friday, December 19th, Mr. J. A. Cooper, Engineer-in-charge of the British Broadcasting Co., gave an instructive paper, dealing with the Birmingham Broadcasting Station. Mr. Cooper dealt with the history of "5 IT" dating back to November, 1922, when the station was situated at Witton. Some excellent lantern slides, showing the studio and the power plant, etc., were shown.

GENERAL POST OFFICE,

P.O. reference ..... LONDON, E.C. 1.

..... 192

Sir (or Madam),

I am directed by the Postmaster General to say that under new licensing arrangements which will be / were introduced on the 1st January, 1925, the separate type of wireless receiving licence issued at Headquarters for experimental purposes will be / was abolished and one type of receiving licence only, available for all purposes, will be / is now obtainable at any Post Office at which Money Order business is transacted. As the fees for existing experimental receiving licences fall due, it will be necessary under the new arrangements to obtain a licence of the new type. The new type of licence affords equal facilities to those enjoyed under the old form of experimental licence.

The period covered by the fee paid for the experimental licence in respect of your station at .....

expires on the last day of the current month, and if it is desired to maintain the station after that date, a receiving licence of the new issue should be obtained within fourteen days of the date of expiration. Such a licence can be obtained by application personally or by post to the Postmaster of ..... or, if preferred, on application at the most convenient local Post Office.

Where a portable station is used, in addition to a fixed station, a second licence is necessary.

If it is not desired to maintain the station, I am to ask you to be so good as to inform the Postmaster of ..... to that effect as soon as possible, and say whether your apparatus has been dismantled.

I am,

Your obedient Servant,

H. N. BUNBURY,

Comptroller and Accountant General.

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An interesting circular which has been received by holders of receiving licences. This circular, which sounds the knell of the Experimental Licence, is discussed under Radio Topics in this issue.

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READERS PROBLEMS

Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

EFFICIENCY OF "SPADE" TUNING AND SCREENING PLATES.

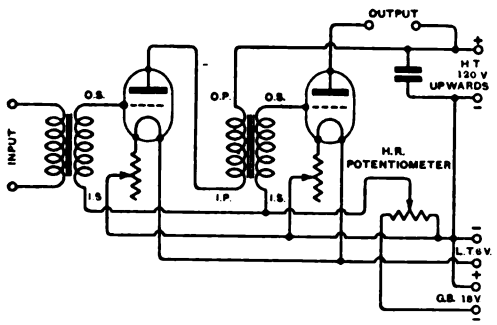
A CORRESPONDENT writes criticising the placing of metal screening plates at the back of the panel of wireless receivers, in order to avoid hand capacity effects, owing to losses by eddy currents set up in the plate. Another correspondent writes condemning the growing practice of using "spade" tuning as being technically bad practice for similar reasons.

Experience has shown very conclusively, however, that provided a metal of high conductivity is used for the "spade" tuner or screening plate, as the case may be, the losses due to high frequency eddy currents of small amplitude are negligible.

It is this fact that has made possible the use of this form of tuning, which is coming more and more into favour both with manufacturers and home constructors.

A DISTORTIONLESS POWER AMPLIFIER.

WE give below a diagram of a distortionless power amplifier designed to give maximum amplification and minimum distortion.



A power amplifier giving high quality reproduction.

The transformer method of coupling is used, and provided that transformers and valves are correctly chosen, and that correct values of filament current, anode voltage, and grid bias are used, the quality of reproduction will fall very little short of the best type of resistance-coupled amplifier without the attendant high anode voltage and loss of amplification peculiar to this instrument.

If the amplifier is intended to follow a valve receiver employing ordinary general purpose valves, the first transformer should be of the 2·7 to 1 type, but if a D.E.5 type of valve is used as a detector, or the amplifier is designed to follow a crystal set, a 4 to 1 ratio may be used. A higher ratio is not recommended in any case. The valves used should, of course, be power amplifiers, and can be either of the D.E.5 or the L.S.5 type.

If the former, a 4 to 1 transformer is recommended, although a 6 to 1 ratio can be used if one is prepared to sacrifice a certain amount of quality. A 4 to 1 ratio, however, is recommended for best results, but with valves of the L.S.5 type a 6 to 1 ratio is permissible. With regard to correct anode voltage and grid bias, a suitable table is given below:

D.E.5 and similar types.		L.S.5 Type.	
Anode Voltage.	Neg. Grid Volts.	Anode Voltage.	Neg. Grid Volts.
80	2 to 3	120	8—9
100	3 to 4	150	9—10
120	4 to 5	200	11—12
		250	13—14
		300	15—16
		350	18—19
The 120 volt value will be found to give best results.		120 or 150 volts on the anode is quite sufficient for normal working.	

THE THERMOFORMER.

WE have received a large number of enquiries from readers regarding the "Thermoformer," concerning which an article appeared in a recent issue. Most of the enquiries are concerning its practicability, and whether it is entirely suitable for supplying L.T. or H.T. for valves from A.C. mains or from D.C. mains in cases where a persistent commutator ripple is known to exist. Readers also desire to know where this instrument can be purchased in this country.

Owing to the principle of operation of this instrument, it should be entirely suitable for operating off D.C. or A.C. mains. It should be distinctly understood that the instrument embodies

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two distinct electrical circuits with no connection between them, and the house lighting mains are never at any time in electrical contact with the receiver circuits; the lighting mains are used to supply energy, not as electricity, but in the form of heat, and in this transference of energy all commutator ripples, etc., naturally disappear.

There are many advertisements appearing at the present time in American radio periodicals, in which cabinet sets of the more expensive type are advertised as operating from the house lighting circuits by means of this instrument, which is built into the receiver cabinet, a length of flex and an adaptor being provided for connection to the lamp socket. Both L.T. and H.T. of varying values, suitable for the different valves in the receiver, and also grid bias, are derived from this instrument.

So far as we are aware, no agents have yet been appointed to handle this product in this country, and we recommend that all enquiries for further details of this instrument should be addressed to the manufacturers, whose head office address is as follows: The Sabin Electrical Products Corporation, 15 Warren Street, New York City, U.S.A.

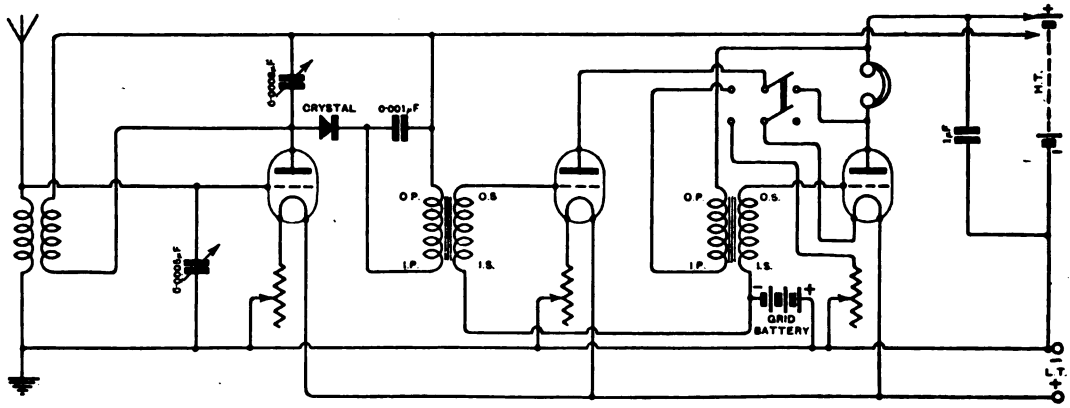
be power valves such as the B.T.H., B.4, the D.E.5, or similar types in other makes. A suitable anode voltage for these valves is 120 volts, with 4 or 5 volts negative grid bias. The high frequency valve can, of course, be of the ordinary "R" type.

APERIODIC AERIAL COUPLINGS.

IT is very common practice in short wave receivers to use a tuned secondary circuit connected between grid and filament of the first valve, and to couple this tuned circuit to the aerial by means of a few turns of wire, wound over the secondary winding. The method has several advantages for short wavelengths. The number of adjustments is reduced, as it is no longer necessary to tune the aerial circuit, or to vary the coupling with the secondary circuit. In addition, a step-up of voltage is obtained, which would not be obtained if the receiver were directly coupled to the aerial. The signal strength obtained is perhaps not so great as would be obtained with two tuned circuits variably coupled together, but, owing to the simplification of the controls, far more stations are likely to be received.

A reader who has obtained successful results with aperiodic coupling on short wavelengths has been trying to extend the principle to long waves without success, and asks if this system is practicable on wavelengths above 600 metres.

It is possible to employ this method on any wavelength, provided that a sufficiently close coupling can be obtained between the aerial and secondary circuit. The losses due to loose coupling are much more likely to be noticed on long than on short wavelengths. Assuming, however, that the maximum possible coupling between the aperiodic aerial and tuned secondary circuits has been obtained, it is doubtful whether on long wavelengths the signal strength would be greater than that obtained by direct coupling to the aerial circuit. In general, a coupled aperiodic aerial circuit should be employed only in short wave receivers.



A valve-crystal circuit giving good reproduction and ease of control.

A VALVE-CRYSTAL CIRCUIT FOR PURE REPRODUCTION.

A READER desires to construct a set suitable for the reception of two or three B.B.C. stations, at least one being at good loud speaker strength. He desires that particular attention be paid to the elimination of distortion in the low frequency portion of the set, and specifies that a crystal must be used for rectification purposes, in order to assist in attaining the desired standard of purity.

We illustrate a suitable circuit above. The crystal rectifier is preceded by a stage of high frequency, using the tuned anode method of coupling, and a reaction effect is obtained by coupling the anode coil back on to the aerial coil. As a crystal is used for rectification there is no special need to employ a low ratio transformer in the first stage, and both transformers should be of 4 to 1 ratio. Both, however, should be of good make. The valves employed should preferably

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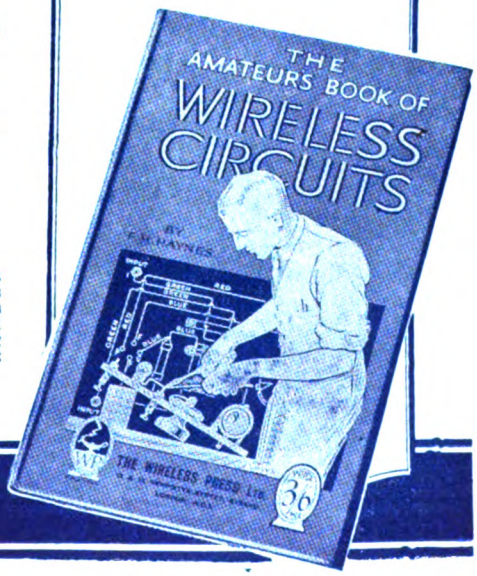
Contains the following special features. It is the most complete and easily understood circuit book available to-day :—

Copious notes on Crystal Receivers, single-valve sets, high frequency, low frequency and dual amplifiers, transmitting circuits. Several pages of most useful data have been added, including the method of pile windings, tables giving tuning range of commercial types of inductances, wavelengths produced by various tuning condensers, types of receiving valves and their characteristics, etc., etc.



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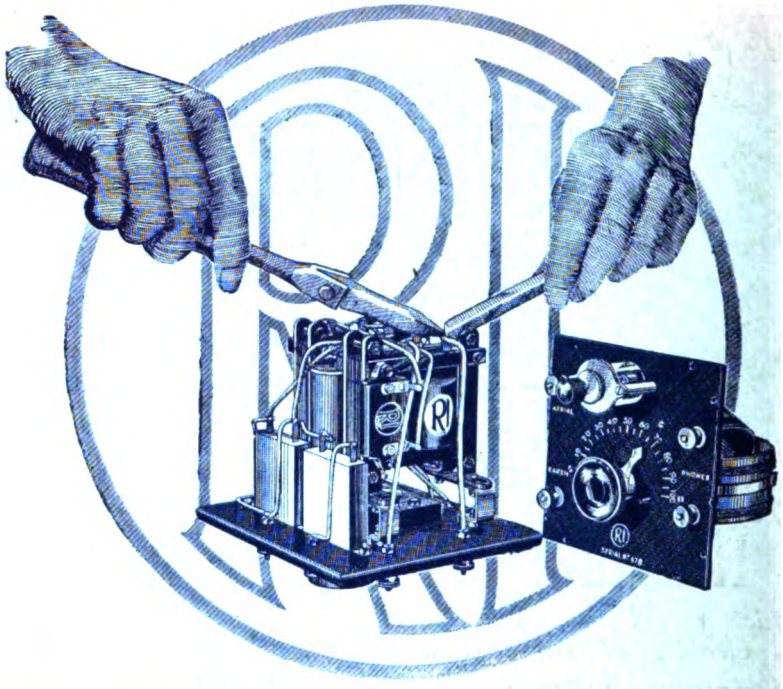

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What another enthusiast says—

Messrs. Radio Instruments, Ltd., London.

I should like to inform you that I am using two of your L.F. Transformers in a loud speaker public address system.

These transformers are giving every satisfaction and are standing up well with 160 volts on the plate using power valves.

The amplification is as good as a seven valve resistance coupled amplifier, and is not distorted.

I may say that within four days I burnt out five transformers of other makes. This will give you some idea of the test that your instruments are undergoing.

I shall be fitting two into my wireless set at a later date.

Yours faithfully,
(Sgd.) Harry V. McCalla.

Engineer Palace, Gateshead.

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CONSTRUCTING AN "IDEAL" THREE-VALVE RECEIVER

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SPEAKING FILMS

No. 282 [No. 15 Vol. XV]

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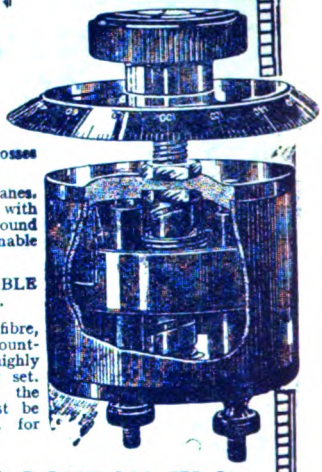

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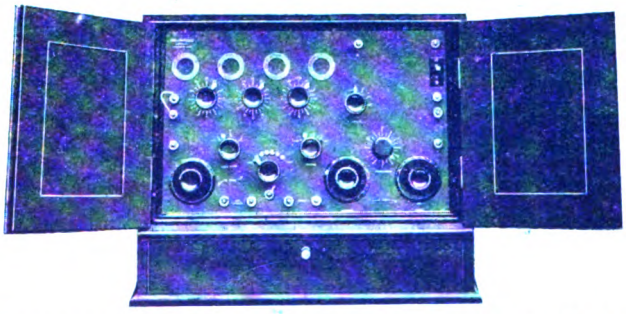

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The WIRELESS WORLD AND RADIO REVIEW

WIRELESS AND SCHOOLMASTERS.

By The Editor.

THERE has been considerable discussion in the daily Press recently on the question of whether broadcasting in the home is going to have a detrimental effect on the standard of education of the next generation. It has been pointed out that quite apart from the fascination of wireless for the average schoolboy, which has the effect of tempting him to devote the whole of his spare time to the subject, there is also the question of home-work; at least one headmaster has written to the Press complaining that home-work is being neglected and that the excuse is given that the loud speaker at home has made concentration impossible.

We are quite prepared to admit that broadcast reception with a loud speaker is no aid to study and if boys are expected to do their home-work in the same room in which the loud speaker is in use, then they have every excuse for neglecting their home lessons. The broadcast programmes would, in part, tempt the boy to listen or, if they did not do so, would at least be a distracting accompaniment to study. But broadcasting and a loud speaker are not the only possible causes for interference with home lessons and surely the responsibility rests with parents to see to it that reasonable quiet is afforded for the period of the evening during which home-work is to be done. We cannot imagine that parents would be so blind to their responsibilities in the matter of a son's education as to expect him to progress in his studies whilst affording him no suitable facilities.

For boys who detest home-work there have always been temptations which could serve to distract their attention. Stamp collecting and a host of other hobbies were in existence long before broadcasting was introduced but these do not seem to have caused the same amount of anxiety on the part of schoolmasters. The purpose of home-work is not only to cram into the day work in excess of that which can be done during the supervised hours in school, but to give the student the opportunity of training himself to study on his own without the moral support to concentration which school supervision provides. If the scholar does neglect, as we may suppose, the study of say Greek and Latin, we believe that the broader education which he can derive from listening to broadcasting may at least be of equal benefit in his future career.

Broadcasting provides a means of general education which past generations have been denied and if one weighs in the balance the advantages against the disadvantages of broadcasting in the matter of education, we believe that the weight will be all in favour of broadcasting.

TO OUR ADVERTISERS.

IMPORTANT NOTICE.

The Proprietors of *The Wireless World and Radio Review* beg to announce that the arrangement whereby Messrs. Bertram Day & Co., 9 and 10 Charing Cross, S.W.1, have acted as sole advertisement representatives, has been terminated by mutual agreement, as from December 31st, 1924, and that in future all communications on the subject of advertisements, together with advertisement copy, blocks, etc., should be sent direct to the offices of the paper at 12–13 Henrietta Street, Strand, W.C.2.

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SPEAKING FILMS

By C. F. ELWELL. M.I.E.E.

One of the first public demonstrations of the speaking film was given before the Radio Society of Great Britain by Mr. C. F. Elwell on December 17th, 1924. Although primarily intended to be a demonstration, the lecturer described in some detail the development of the system and we publish his remarks in the present article.

SEVERAL decades ago the study of the phenomena associated with the discharge of electricity from hot bodies was entirely in the hands of physicists. To-day applications of thermionics in telephone, telegraph and radio engineering, as well as other branches of pure and applied science, represent a considerable percentage of the applications of electricity for the benefit of mankind. A year or two ago the study of photo-electrics or electrical changes brought about by the action of light was mainly in the hands of physicists, and there were not many applications from an engineering point of view. Much has happened in the last two years, and one would be bold to say that the research work done in photo-electrics has been done in vain. With more minds familiar with the subject, there is no saying what valuable applications may be discovered in the next decade. The large number of keen and skilled amateurs now working with thermionic phenomena constitutes an army the potential mental strength of which is enormous. From thermionics to photo-electrics is a very short step, and within the next few years I am sure there will be other papers on applications of photo-electrics read before this Society. At the present time photo-electrics owes a lot to wireless. Photo-electric currents are so small that practical applications would certainly be few if it were not for the three-electrode valve amplifier. Currents of the order of one-hundred-millionth of an ampere is what one has at one's disposal from photo-electric cells. But by means of valve amplifiers these small currents can be increased at will. Both the photo-electric cell and the valve amplifier are utilised in talking motion pictures. You can, therefore, see that talking motion pictures have to do with wireless, and the matter is attached to your past work, and they are also indebted to photo-electrics, which I am sure will not be unknown to you in your future work.

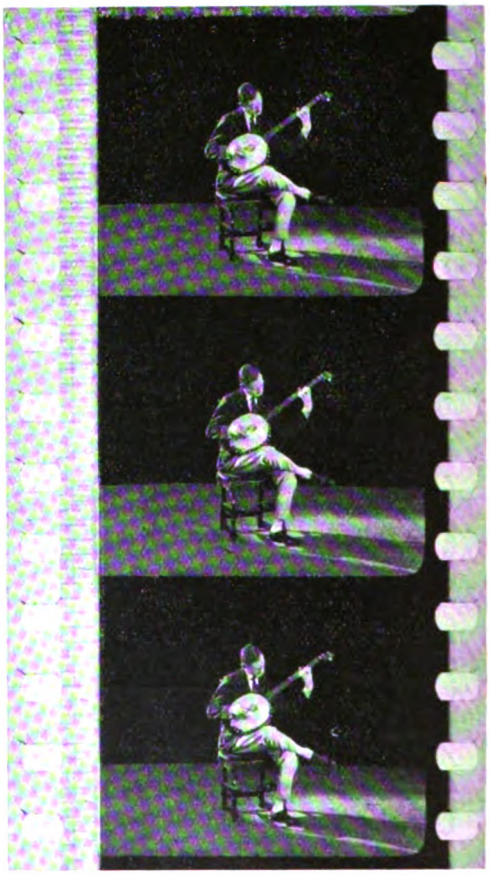

Fig. 1. A short length of film showing the pictures, and on the left, the sound record consisting of a number of lines of varying width but constant length.

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Now to turn to talking motion pictures. Inventors have been dreaming of them ever since motion pictures became an established fact. The first and palpable method was to synchronise the moving picture with a gramophone record. First came the "Cameraphone," the method employed being to take the motion picture while a stock wax cylinder type of record was being played. The actors sang, or pretended to sing, and the camera photographed the lip motion.

Then Thos. A. Edison, with his "Kinetophone," made a distinct step in advance by making the phonograph record simultaneously with the taking of the motion picture negative. Results were far superior, as the synchronisation of the sounds with the lip motion was good, but the reproduction of this synchronisation was difficult, as so much depended upon the skill of the operator, who generally had another man to start the phonograph record and keep it in step.

Other inventors tried to improve upon these methods, and many patents were taken out on mechanical and electrical devices for keeping the sound record and the picture exactly in step. When the film became mutilated the difficulties became greater.

Wireless, through the medium of the three-electrode valve, has made perfectly synchronised talking motion pictures a reality.

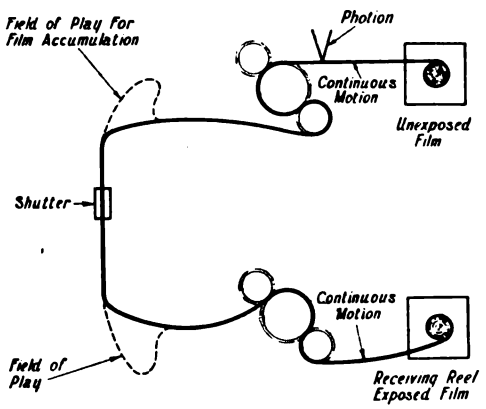

Fig. 2. A schematic diagram explaining the method of recording sound on the film.

I will first describe how sound is recorded simultaneously with the taking of the picture, and upon the same standard film as the picture, and then how the photographically-recorded sounds are reproduced, and then you will note the part played by photo-electrics.

Dr. de Forest conceived the idea of making talking motion pictures, or "phonofilms," as he called them, quite a number of years

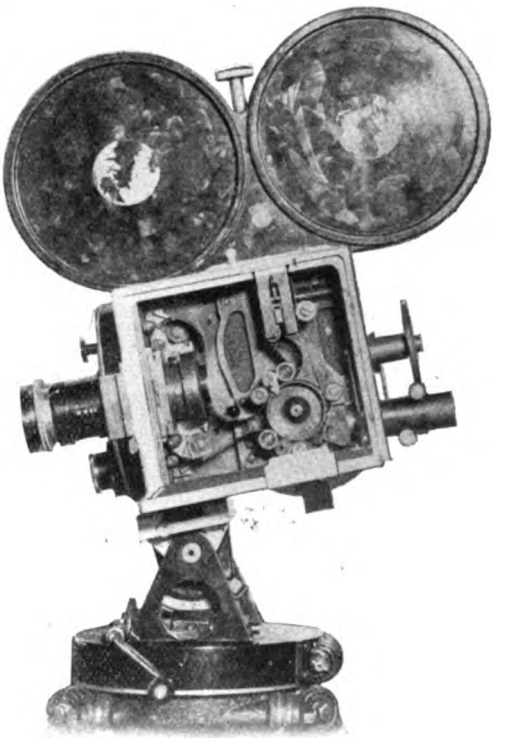

Fig. 3. The camera employed when taking motion pictures simultaneously with the sound record.

ago. It was only recently that he attacked the problem, and he then laid down as a first essential to the commercial success of these "phonofilms" that only standard film, as used in the cinema, should be employed. On a narrow strip only 0·1 in. wide he has succeeded in recording all kinds of sounds. The balance of the width of the film, which, as you know, is 1 in. in width, is used for the picture in the ordinary way. This narrow sound record is marked with a large number of light and dark horizontal lines, varying in width, but not in length (Fig. 1).

How is sound, as represented by these lines, recorded upon this narrow strip of celluloid? In reality it is all very simple, with the aid of the three-electrode valve.

Fig. 2 represents a film on edge. The picture is taken in the ordinary way by

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means of the ordinary cinema camera, and the method consists of holding the piece of negative in position for a fraction of a second, taking the picture, pulling the film down, and taking another picture, and so on. In ordinary cinematograph work about 16 pictures are taken per second, but in our work we take about 20 per second. The sound must be put on continuously; we could not have the spaces between the pictures, for example, appear in a sound record. A sound record must be continuous, so that it is put on the film before the jerking action takes place. In the camera a small gas-filled lamp is placed. The method of recording is as follows:—The sounds emitted by the speaker are picked up by means of a very sensitive microphone. The very small electric currents, which represent the sounds emitted before the microphone, are highly amplified, and this is done in order that the variations of the electric currents shall be large enough to affect the light emitted by the lamp in the camera. The lamp consists really of a two-electrode valve. The lamp is called by Mr. Case the A. E. O. —alkali-earth-oxide. These amplified currents, representing speech before the microphone, vary the actinic light from the lamp. The light is allowed to shine through a very fine slit, placed as close as possible to the celluloid film. It is one and a-half thousandths in width, and you can see that a steady light will print a line on the portion of the film reserved for the sound record. The sound record is 0·1 in. in width, and if the film were standing still a line one and a-half thousandths wide and 0·1 in. long would be recorded. The variations of the intensity of the light from the lamp are thus recorded

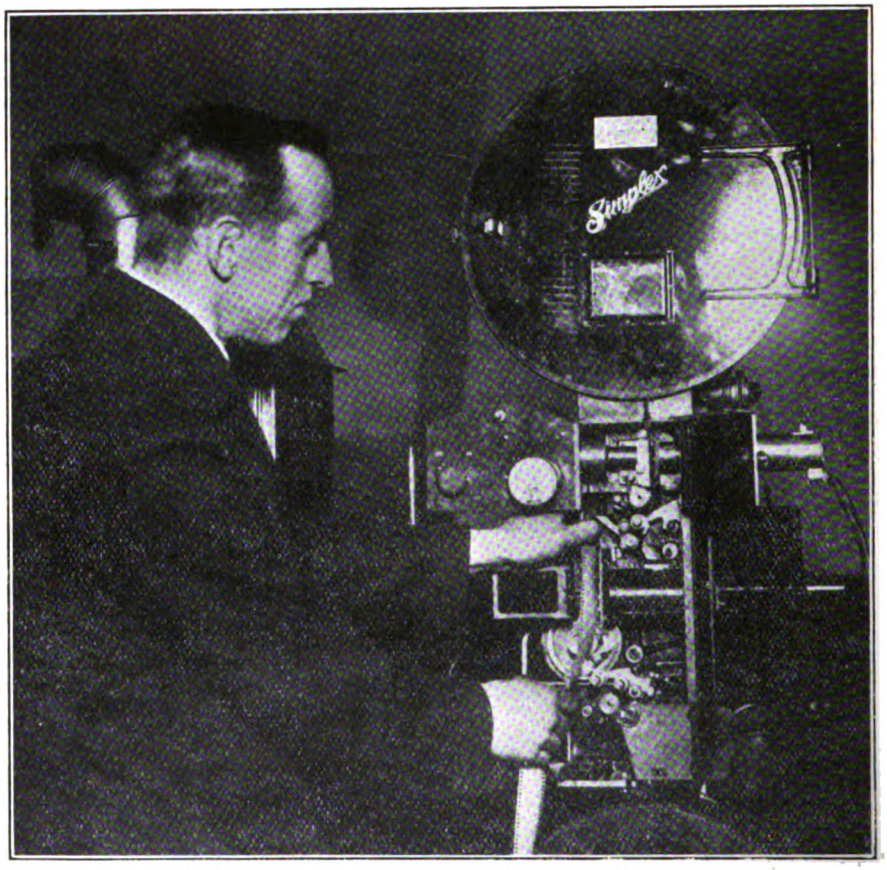

Fig. 4. A cinema projector fitted for "speaking films."

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photographically on the film in the form of horizontal lines of varying width and gradations of black and white. From the negative, after development, any number of positives can be made.

Fig. 3 shows the camera for taking motion pictures simultaneously with the sound record. This method guarantees perfect synchronisation. There are two lenses, one for focussing and the other for taking the picture.

The next question is, "How are these photographic sounds reproduced?" The roll of positive film is placed in an ordinary cinema projector (Fig. 4) to which has been fitted an attachment containing a small incandescent lamp, a fine slit of similar dimensions to that used for taking sound records, a guide for the film, and a photo-electric cell. The light from the small incandescent lamp (Fig. 5) shines through the fine slit, and the film is guided so that the portion of the film upon which the sound is recorded passes before the illuminated slit. The intensity of the light which passes through the more or less translucent film is governed by the number and width of the horizontal lines. This fluctuating beam of light falls on the photo-electric cell, and it is the property of a photo-electric cell that its resistance changes with the intensity of the light falling upon it. The cell we use, and which must be used for talking motion pictures, must be instantaneous in its action, and the photo-electric cell invented by Mr. T. W. Case, and known as the Thalofide cell, is used. It consists of a deposit of

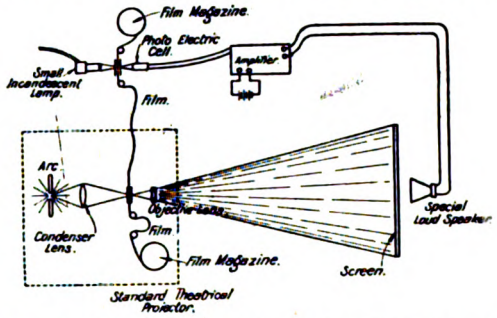
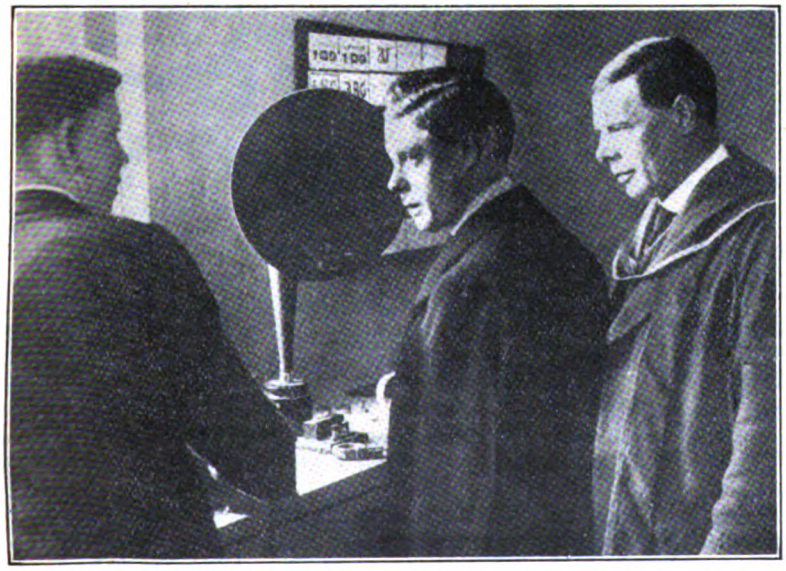


Fig. 5. The arrangement of the apparatus for reproducing the film simultaneously with the sounds.

thallium and sulphur on a quartz disc, ¾ in. diameter. It is very sensitive in action, but of very high resistance, sometimes as much as 500 megohms. The current from the cell is taken through an amplifier and amplified sufficiently to enable it to actuate the loud speaker. Remember that the sound has had a long journey through the air. The microphone current, have been amplified, taken through the two-electrode valve, the light from this has been passed through a fine slit, and has been recorded on a film. This has then been through a photographic bath, and a print has been made from it. For reproducing, there is a small incandescent light shining through the slit, through the film, on to the cell, there is amplification again, and finally, the loud speaker, which is probably the weakest link in the chain. I think you will agree that the results are wonderful, when you consider the long path through which the sound has passed.



The interest which H.R.H. the Prince of Wales takes in wireless matters was again shown when he recently visited 2SZ, the Mill Hill School Wireless Station. The photograph shows the Prince conversing with Mr. C. W. Goyder, the operator.

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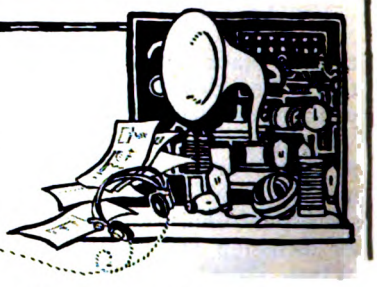
NEW APPLIANCES.



Sparta One-Valve Amplifier.

This is a very simple and neat instrument of compact construction and makes use of a dull emitter valve of the 0.06 type. It corresponds in overall dimensions with the Sparta crystal set, for which it is intended for use as a single low frequency amplifying stage. When once the filament resistance has been adjusted the case can be closed, thus safeguarding the valve from breakage.

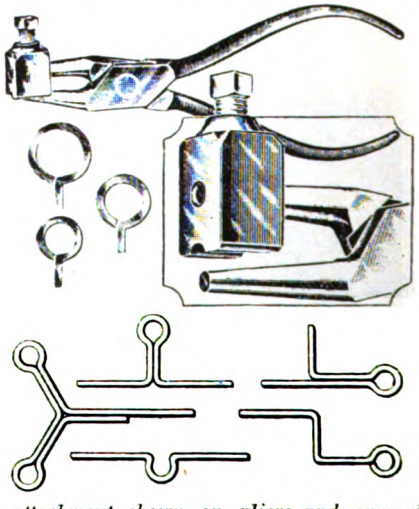
A novel arrangement for an amplifier by Fuller's United Electric Works, Ltd.

Glazite Connecting Wire.

Intended to replace the ordinary tinned copper wire, this latest product of the London Electric Wire Company and Smiths, Ltd., has a coloured covering which gives ready identification of the various leads and prevents short circuits should the wires be pressed into contact. The covering is both damp and flame proof, and is obtainable in four colours: red, blue, yellow and black. Not only does the use of this wire prevent accidental short circuit between the leads, but it gives a very attractive appearance to a receiving set. It is difficult, however, to make "T" joints owing to the fraying of the protective covering, but this is no disadvantage for it is much more satisfactory to distribute all these from a strip of connecting tags.

Wire Bending Pliers.

Supplied as an attachment for fitting to round-nosed pliers this clever device produces, with great rapidity, looped bends of uniform size. The advantage is gained that the wiring may be given suitable bends whilst in position, and without removing it as is usually the case when using ordinary square-jawed pliers. It is a product of the Rockwood Co., Ltd., to be found amongst their useful range of tools specially designed for instrument work.



The attachment shown on pliers and examples of their use.

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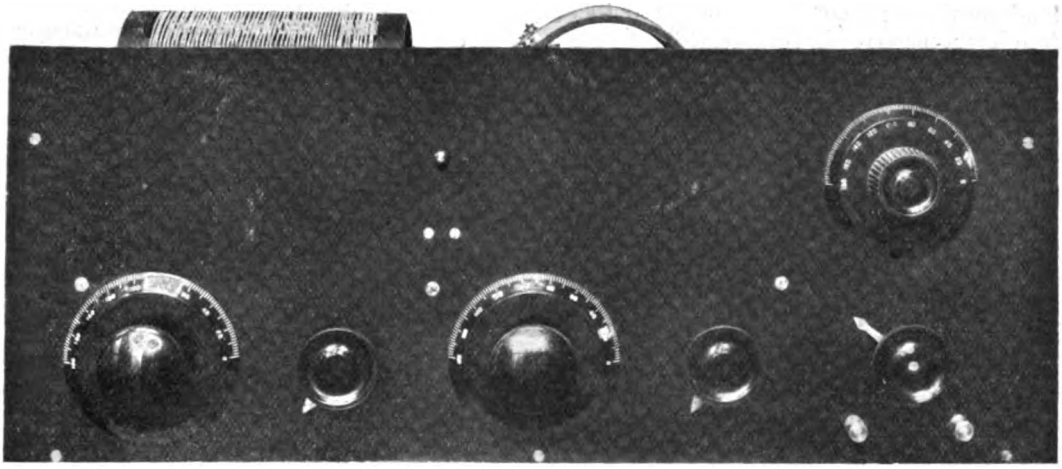

A front view of the receiver showing the tuning condensers, neutralizing condenser, filament resistances, variometer and switch and the tops of the H.F. transformers.

IDEAL RECEIVERS—II.

A THREE-VALVE RECEIVER.

With one H.F., Valve Detector, and one stage of L.F.

In the following article we describe the construction of the Three-Valve Receiver discussed in the last number of this journal.

By W. JAMES.

THE REACTION VARIOMETER.

IT will be seen from the theoretical diagram (Fig. 1, page 439 of last number) that a variometer is connected in the anode circuit of the detector. A large variometer is employed with a switch to connect the windings in series or parallel. If the receiver is to be employed principally for the reception of short wavelength signals, there is no need to use such a large variometer with a switch—a small variometer of the ordinary type, such as is used in receivers tuning over about 300-500 metres may be employed instead. The purpose of this variometer is, of course, to provide reaction effects, and so to enable one to increase the signal strength and selectivity. Should the variometer be so adjusted that oscillations are produced, these will be confined to the detector valve circuit, and will not reach the aerial, because the first valve is "balanced." The increase in signal strength and selectivity obtained by adjusting this variometer is well worth while, and does not complicate the tuning of the set. When the desired signal is heard, it is only necessary carefully to adjust the variometer and second tuning condenser, C_2.

A fixed condenser, C_5, of 0·001 microfarad, is connected across the transformer to carry the high frequency component of the rectified current.

THE NORMAL GRID VOLTAGES.

The grids of the valves are given a suitable normal voltage as indicated in the figure. For the first valve (the H.F. amplifying valve) the grid is made about 1·5 volts negative by a single dry cell connected between the grid return wire and the negative side of the filament battery; this is a suitable bias when a D.E.5 type valve is employed with an anode voltage of about 60 volts, or a D.E.5 B valve with 120 volts.

To obtain good rectification, the grid return wire of the tuned circuit connected to the grid of the detector is connected to the positive side of the filament.

The third valve, which is coupled through a transformer to the detector, works into the

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loud speaker or head telephones, and therefore has a negative bias of 4½ volts obtained from a three-cell unit. This bias is satisfactory when a D.E.5 type valve is employed with an anode voltage of 120. When the set is used at a place about 15 miles from the 2 LO broadcast station, however, I find the grid bias should be about 12 volts negative, with a correspondingly higher anode voltage. The signal strength is very great—sufficient, in fact, to overload ordinary household loud speakers—and the quality of the signals is excellent. Control of the volume may be obtained by adjusting the view to obtaining the strongest possible signals. A very satisfactory combination comprises a D.E.5 B valve and a Marconiphone 6 to 1 Ideal transformer.

THE NEUTRALIZING CONDENSER.

This is a variable condenser having a maximum capacity of about 10 micro-microfarads. There are a number of condensers on the market which are quite suitable for use in this receiver.

CONSTRUCTION OF THE RECEIVER.

The accompanying photographs and drawings show the construction and wiring of the

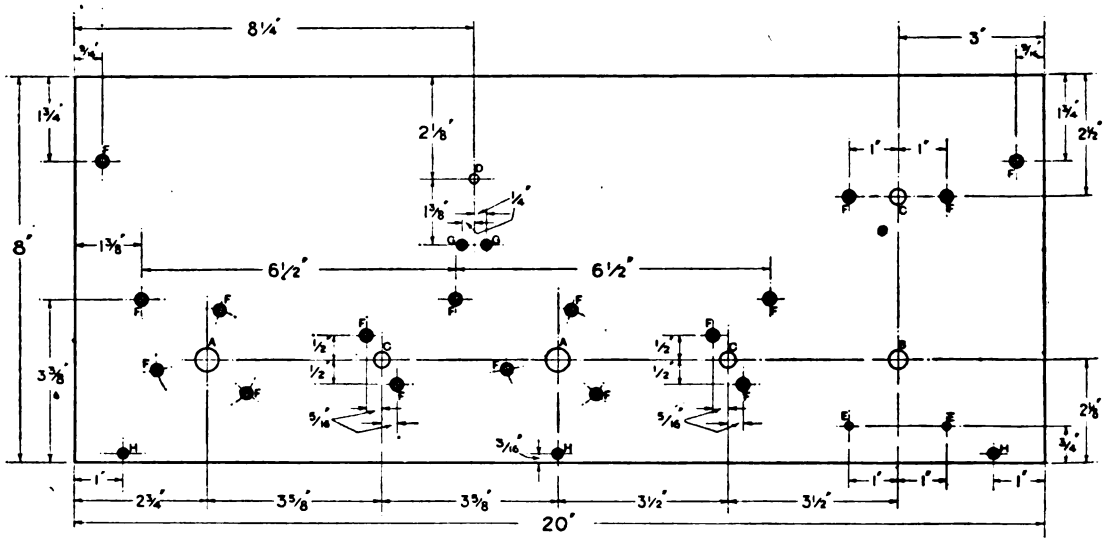

Fig. 3. Layout of ebonite panel with particulars of the holes when Burndept 0·0002μF tuning condensers, Ormond filament resistances, an Igranic type S.R. variometer and a Utility three-pole switch are employed. When other components are used, modify the layout accordingly. Drilling details:—A, ¼ in. dia.; B, ⅜ in. dia.; C, 5/16 in. dia.; D, 3/16 in. dia.; E, 5/32 in. dia., countersunk; G, ⅛ in. dia., countersunk; H, ⅛ in. dia., countersunk.

variometer, the filament current of the first valve, and the anode voltage of the detector valve.

THE L.F. TRANSFORMER.

When the receiver is employed for telephony, the first requirement is good quality. The intervalve transformer, T_3, is therefore chosen to match the detector valve, and in this instance a Marconiphone Ideal transformer having a ratio of 4 to 1 is employed with a D.E.5 type valve as the detector. For the reception of Morse signals, however, the principal requirement is volume. Distortion does not matter. Hence the transformer and valves should be chosen with a receiver. There is an ebonite front panel measuring 20 ins. by 8 ins. by ¼ in., which carries the tuning condensers, neutralising condenser, filament resistances, variometer, variometer switch, and telephone terminals. This panel is fastened by two brackets to a base of hard wood measuring 19¼ ins. by 8⅞ ins. by ⅜ in., which supports the low frequency transformer, grid battery G_2, fixed condenser C_5, the anode battery condenser C_6, and the terminal strip. The baseboard also carries the coil and valve platform. Three-ply wood is employed in the construction of the platform, with pieces of ebonite, and the valve holders let in at suitable points.

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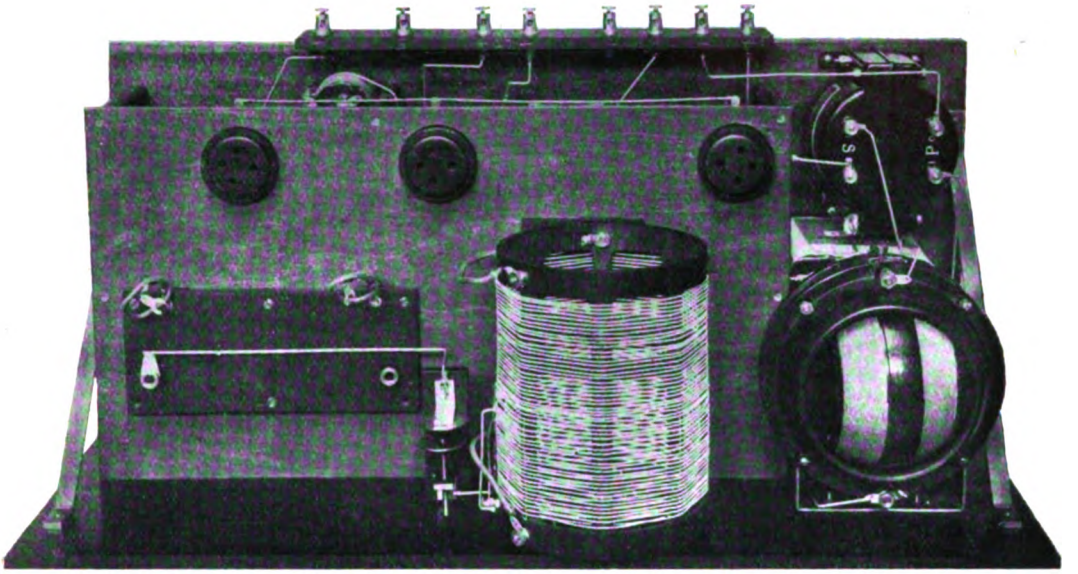

Fig. 4. A view of the top of the receiver showing the connection strip, the valve holders, one coil-holder, one coil, the neutralizing condenser, the variometer, the L.F. transformer, and the grid battery.

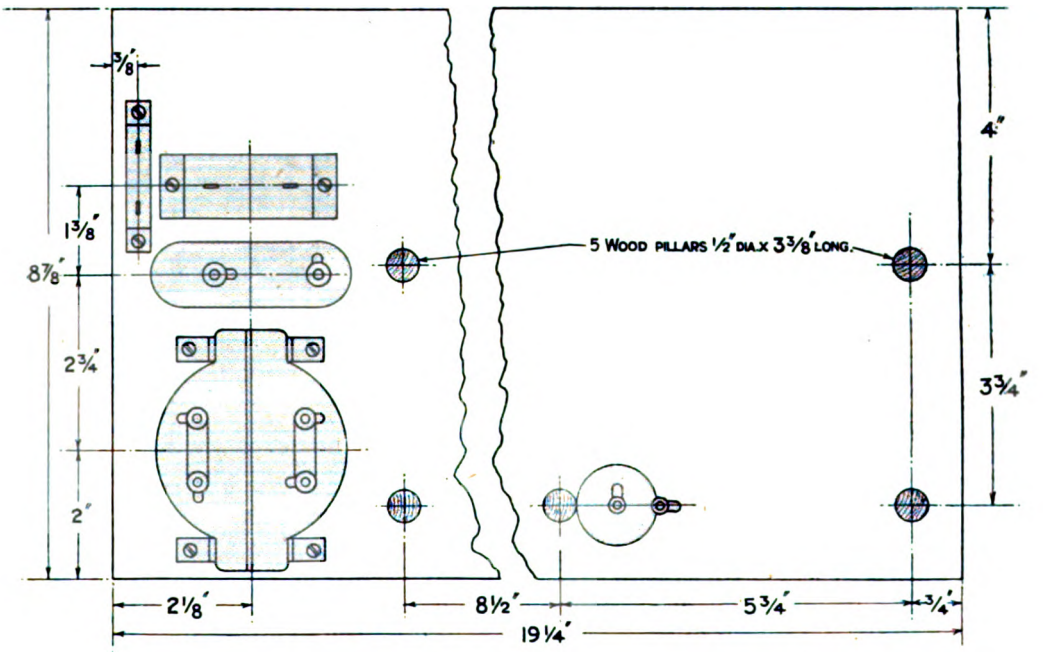

Fig. 5. Details of baseboard. A Marconiphone Ideal transformer, Burndept 4½ volt grid battery, two fixed condensers, a single dry cell, five wooden pillars and a terminal strip are mounted.

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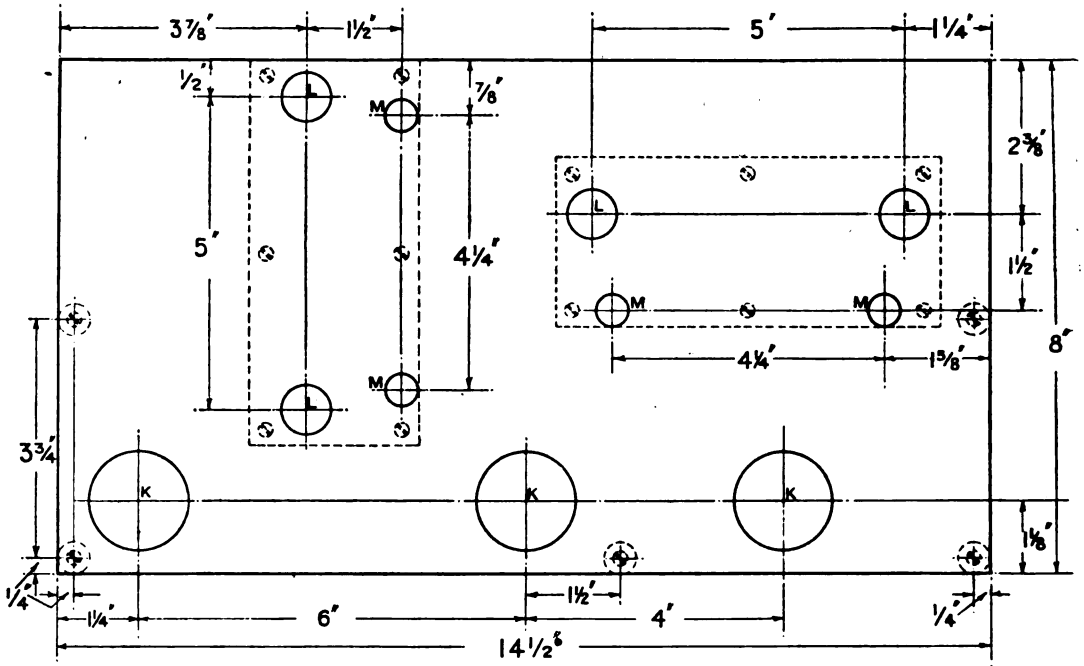

Fig. 6. Details of platform, which is of three-ply wood. Drilling details:—K, $1\frac{5}{16}$ in. dia.; L, $\frac{1}{4}$ in. dia.; M, $\frac{1}{8}$ in. dia.

Commence the work by trueing the $\frac{1}{4}$ in. ebonite panel to 20 ins. by 8 ins., and mark it out in accordance with the drawing of Fig. 3. Then drill the panel, and finally, assemble the components and see to the action of the resistances and condensers. The appearance of the front of the set when assembled is clearly shown in the photograph at the head of this article.

Then attend to the baseboard. This should be of a hard wood, measuring $19\frac{1}{4}$ ins. by $8\frac{7}{8}$ ins. by $\frac{3}{8}$ in., and have the components arranged on it as indicated in Fig. 5. It is secured at right angles to the ebonite panel by two brackets, as may be seen from Fig. 4.

Next secure a piece of three-ply wood measuring $14\frac{1}{2}$ ins. by 8 ins. (Fig. 6). This is supported on five short pillars of round wood, $\frac{1}{2}$ in. diameter by $3\frac{3}{8}$ in. long, which have their ends screwed to the baseboard. Mount the three valve holders (Burndept anti-phonic valve holders are employed in this set) by cutting holes in the platform as indicated in the figure, and fix them so that their bases are below the platform, while the tops of the holders project a little above the surface. Two pieces of ebonite are let into the platform. Details of these pieces are given in Fig. 7, and the portions of the platform to be cut away are indicated in Fig. 6. On the ebonite pieces are mounted sockets to take the pins attached to the coils,

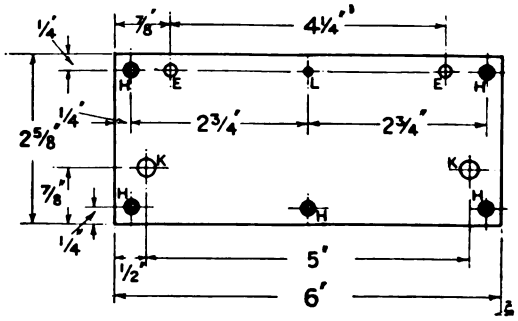

Fig. 7. Details of ebonite pieces for platform. Drilling particulars:—E, 5/32 in. dia.; K, $\frac{1}{4}$ in. dia.; H, $\frac{1}{8}$ in. dia. and countersunk; L, tapped 4 B.A.

and two small terminals supplied with short flexible connecting wires. The piece of ebonite which acts as a holder for the second H.F. transformer has an additional terminal with a connecting wire, which is employed to connect one side of the neutralising condenser.

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Each piece of ebonite therefore carries two sockets, which are connected to the secondary circuits, two terminals with flexible connecting wires which are joined to the primary windings of the coils, and one has an additional terminal and connecting wire for connecting the tap on the secondary winding of the second H.F. transformer to the neutralising condenser.

Having assembled the whole of the receiver, study the wiring diagram of Fig. 8. It will be seen that there are several wires running between the tuning condenser, coils, filament resistances, and valves, which lie

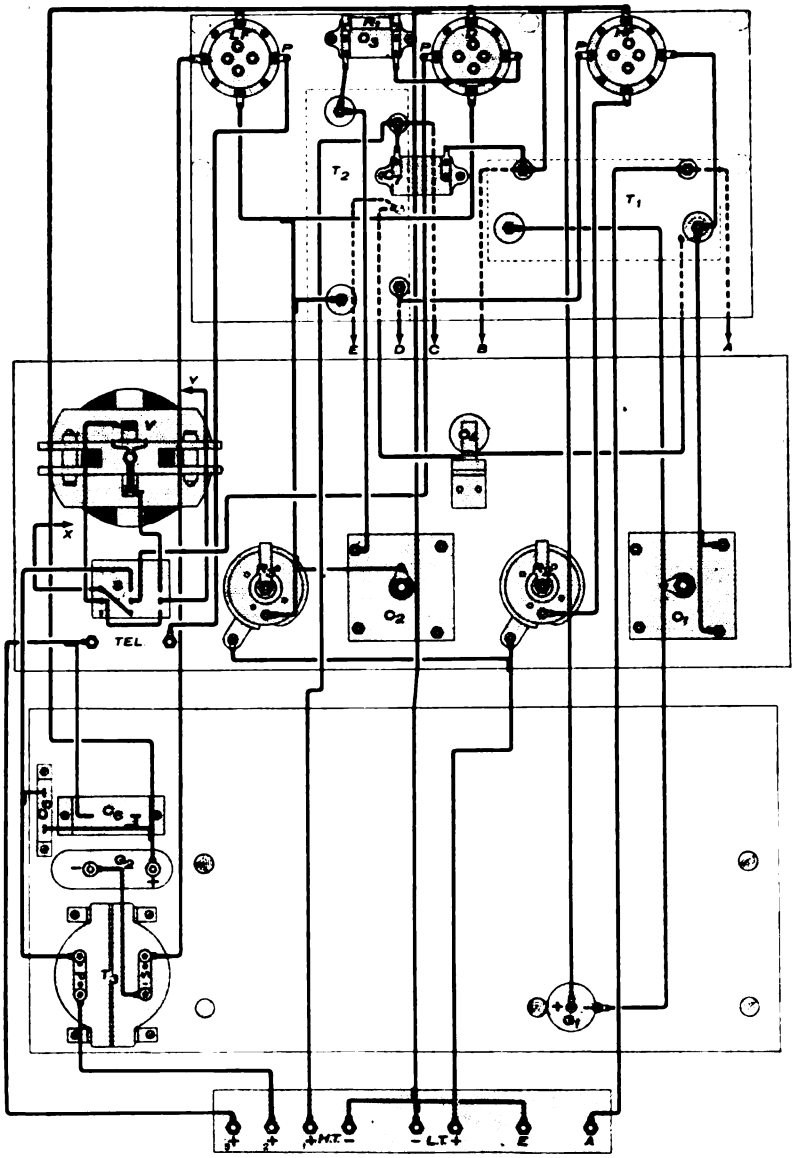

Fig. 8. Wiring diagram. T_1, aerial transformer; T_2, intervalve H.F. transformer; T_3, Marconiphone Ideal transformer; C_1, C_2, Burndept 0·0002 μF tuning condensers; C_3, grid condenser, 0·0002 μF; C_4, neutralising condenser; C_5, fixed condenser, 0·001 μF; C_6, fixed condenser, 2μF; C_7, fixed condenser, 0·002 μF; G_1, one dry cell; G_2, 4½ volt Burndept grid battery; V, variometer; S, series-parallel switch. The wires X and Y connect to the terminals of the variometer on the panel side.

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below the platform. The baseboard should therefore be removed carefully, and these connections made, using a stiff wire, such as No. 18 tinned copper wire. Those wires which connect to the terminal strip should

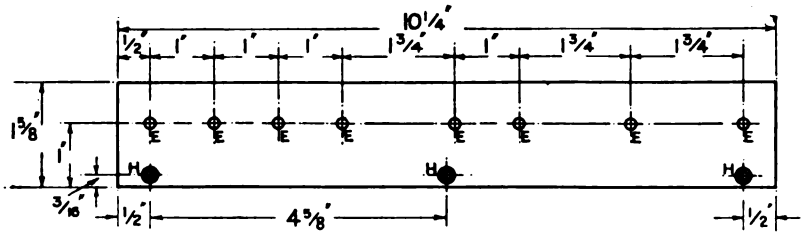

Fig. 9. The terminal strip. Drilling details:—E, 5/32 in. dia.; H, ⅛ in. dia. and countersunk.

be run in the approximately correct position and be soldered to the terminals of the strip later on. Wire also as many as possible of the components mounted on the baseboard. Proceed with the wiring by putting the base board in position and connecting the wires to the terminals of the connection strip.

OPERATION.

With the wiring completed and carefully checked, put the H.F. transformers in position and connect them to the circuit by attaching the flexible wires secured to the terminals on the ebonite pieces let into the platform. Notice that the transformer with the tapping on the secondary winding is the one mounted in the centre of the set. Then connect the aerial, earth, batteries and telephones. Tune in a signal by adjusting the two tuning condensers, with the variometer windings in parallel and set at zero. The condenser tuning the aerial transformer will have a lower value than the one tuning the intervalve transformer. It will probably be found that when the two circuits are in tune the set is oscillating. To neutralise the first valve, turn its filament resistance to the off position and readjust the first tuning condenser; if the signal is still heard, adjust the neutralising condenser until the signal is very weak, or is not heard at all. Then turn the resistance on again, and make a further slight adjustment to the condenser. The correct setting of the neutralising condenser is easily found if the coils have been wound and connected as described above.

Pairs of high frequency transformers may be wound to suit any band of wavelengths. To receive the high-power broadcast station (1,600 metres), the secondary winding may consist of 300 turns of No. 30 S.S.C. wire with a tapping from the 50th turn (from the filament end) of the secondary of the inter-valve transformer for the neutralising condenser, and a primary winding of 50 turns of No. 26 D.S.C.

For a minimum wavelength of 100 metres the secondary windings may have 24 turns of No. 16 D.C.C. wire, and the primary 4 turns of No. 16 D.C.C. wire, with a tapping at the 5th turn for the neutralising condenser.

A simple design for a crystal receiver which is popular in Paris for reception of local broadcasting stations.

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Z 4 AG

A DESCRIPTION OF

THE FIRST NEW ZEALAND STATION TO BE HEARD IN THIS COUNTRY

By RALPH SLADE.

Mr. Ralph Slade here gives in his own words a description of his station and its development. The equipment of the station will probably cause some surprise among experimenters in this country for it is certainly not lavish in its layout.

WHEN the first cable came to hand from Radionic, London, and which I received on October 18th (Saturday morning), I can tell you that I did no more work that morning. I was more excited even than when I first heard the American stations in 1922. It seemed almost impossible to believe at first that my signals had been received in England but, of course, it has more or less been proved that nothing is impossible in wireless nowadays.

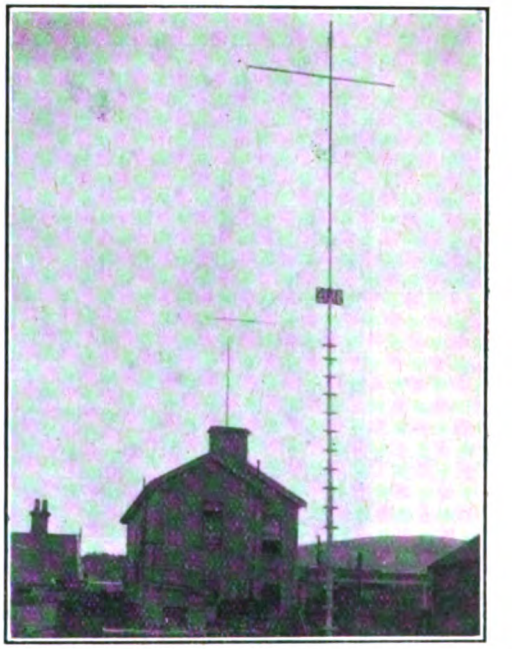
I give below a few particulars of my transmitting and receiving equipment so that those stations with whom I have worked in England and those who have intercepted my signals may know something about the station.

The transmitting circuit used is the four-coil Meissner arrangement, possessing the following features :—

(1) High efficiency—*i.e.*, low input for high output (has far greater output/input ratio than any other circuit I have tried).

(2) Adjustments are not complicated.

(3) All the output is on one wave—the fundamental. Here is a sample of some readings taken in the same town. On 100 metres the audibility of the fundamental was 400, while the audibility of the half-wave was 11 at the most and as low as 8 for different adjustments.



The three-wire aerial. It is 70 feet in height and 43 feet in length.

The half-wave cannot be heard outside the town and yet I can read quite loud the half-wave of Z 1 AH and Z 1 AC (over 650 miles away), while the half-wave of Z 2 AP is 75 per cent. as strong as his fundamental and he is over 400 miles away.

(4) Key thumps negligible.

(5) Interference on waves other than the fundamental nil.

With the old 5 watt set (Armstrong's reversed feed-back circuit) I used to get numerous QRM reports, but do not get any now.

(6) Wave extremely sharp, and several other advantages of minor importance.

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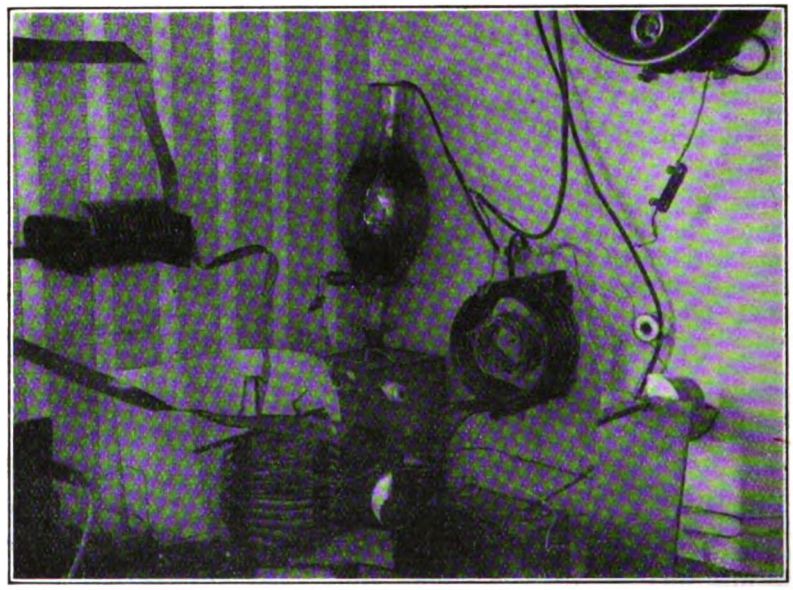
The accompanying illustrations give various views of the equipment and many of the component instruments can easily be identified.

The aerial coils are $5\frac{1}{2}$ ins. diameter, wound with $\frac{1}{4}$ in. copper tube (easier to work than wire). There is 3/16 in. spacing between turns and there are seven turns in each coil.

Aerial and counterpoise leads (no earth used) are of copper ribbon soldered to the copper tube (no clips). These aerial coils are supported by two narrow strips of good ebonite.

in diameter, wound low-loss fashion, with the turns not jammed up too tightly and is of 14 S.W.G. (even this gets rather hot). It must be tightly coupled and it goes better when the current flows through it in one particular direction, depending upon the manner in which the grid coil is connected. Across the plate circuit is what was originally a 0·001 μF variable condenser, but it had to be double-spaced to prevent flash over so that the capacity is now 0·00025 μF. The plate coil is suspended centrally inside the other aerial coil, being hung from the aerial coil supports by the leads from the coil.



Part of the transmitter. The components are simple in design yet undoubtedly efficient.

The grid coil is coupled to the lower aerial coil and just hangs from an ebonite rod, which rests across the ends of the two aerial coil supports. The grid coil is fairly loosely coupled. It consists of 16 turns of No. 14 gauge wire wound low-loss fashion and is $2\frac{3}{4}$ ins. in diameter. Across this coil is a 0·00025 μF variable condenser. A clip also is supplied with this coil for varying the wavelength outside the range of the condenser.

The plate coil in my opinion is the whole secret of the circuit. For high power you must have heavy wire and the coil must be the right diameter. Mine is 18 turns, $2\frac{5}{8}$ ins.

The grid condenser is best at about 0·0001 to 0·0002 μF. For telephony a variable of small capacity is better and I might add that my speech signals have been heard by X 3 AA, 5,000 miles away. The grid leak is at present an old Ford coil secondary. The liquid leaks were tried and work better —for a while—until bubbles of gas form on the metal plates and after which it is useless. Normally the grid current averages about 6·5 mA., but varies between 5 and 8 mA.

The input varies from 100 to 205 watts, but is normally about 150-170 watts. The plate voltage varies a bit, of course, but is

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generally 2,000 and the plate current generally about 80 mA.

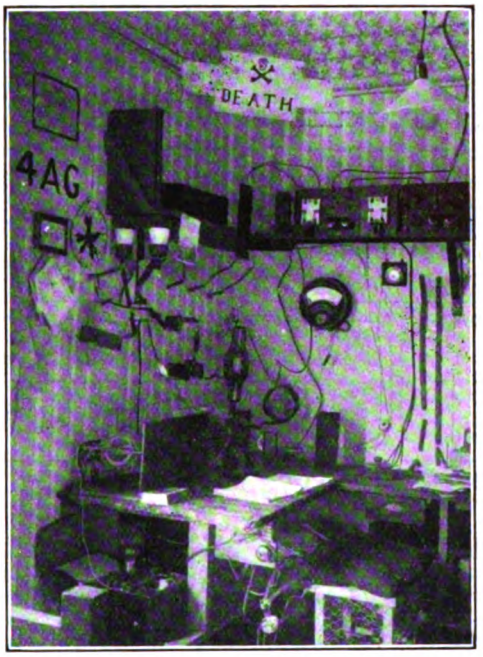
The aerial series condenser has a capacity of 0·00025 μF and is double spaced. The plate by-pass condenser is of 0·002 μF with plenty of mica.

The valve is a Phillips Z.4 and has a plate dissipation of 240 watts but, of course, is worked considerably under the rated value. The normal plate voltage given for this valve is 3,000 and the normal plate current is 300 mA.

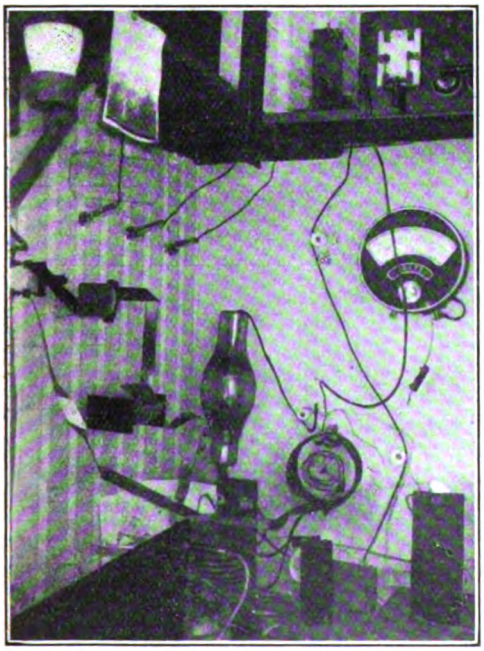
The aerial current at present on 150 watts input is 1·6 amps., but with 205 watts input it is 2·2 amps, on 83·5 metres.

The plate supply is at present fed through two transformers in series delivering 2,500 volts A.C.

I could not obtain a synchronous motor so had to use electrolytic rectifiers. I have 84 2-lb. jam jars in a shed and am using the bridge method with 21 jars in each leg. The aluminium plates are made of $\frac{1}{4}$ in. welding rod, bent double, while the lead plates are 3-lb. sheet lead with about 3 by $1\frac{1}{2}$ ins. immersed in the solution of borax tap water, with a little ammonia added. At first I used to use distilled water, but have given up that idea as the rectifier gets just as dirty with distilled water as with tap water, and the latter is a lot cheaper. The voltage drop across the rectifier is high, being about 500 volts, and as a result possibly wastes about $\frac{3}{4}$ kW.



The complete station.



Another view of the transmitter, showing its simple layout.

When I first started I had a filter, but the filter condensers soon broke down. Although the note is not too good, there are no key thumps. The keying is done in the centre tap of the filament transformer. There are also a couple of $\frac{1}{4}$ μF condensers connected from the centre tap to each of the filament legs.

A grid choke is used wound with No. 19 wire and of about 30 turns, 1 in. diameter.

The aerial is 70 ft. high at the free end and 45 ft. at lead-in. The lead-in is a three-wire cage, 30 ft. long and 1 ft. diameter at top and 5 ins. at bottom. The aerirl is flat topped and consists of three wires, 43 feet in length. Spreader at free end is 16 ft. and at lead-in end is 10 ft.

The counterpoise is a six-wire fan 55 ft. long and is 10 ft. high and encloses an area of 1,500 square feet. The leading-in wires pass through the wall through gauge glasses.

The receiver is the ordinary low-loss type.*

*Q.S.T., February, 1924.

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The valve is a V.24, and has put up a wonderful performance. Some time back it was the only valve I had and I used to put it into the transmitter and send to local amateurs.

I give herewith a concise copy of my log

LOG OF ENGLISH STATIONS RECEIVED FROM OCTOBER 19th to NOVEMBER 9th 1924.

Date	Call.	Wavelength.	Period during which readable.	Audibility.	Max. strength.	Order of Merit.	Conditions.	Weather.
19.10.24	2 NM 12 2 OD 15 5 LF 7	About 100	5.55-6.30 p.m.		About 6.15 p.m.	See Audibility	QRM local valves. QRN bad.	——
20.10.24	2 NM 25 2 OD 21 2 SH 15 2 SZ 7	Between 95 and 101 m.	5.55-6.55 p.m.		About 6.15 p.m.	,, ,,	QRM spk. coil. QRN nil.	——
21.10.24	5 NN 7 2 NM 15 2 SZ 9 2 OD 13	,, ,,	? -6.45		About 6.25 p.m.	,, ,,	Power leaks bad ..	Fine and clear, little wind.
23.10.24	2 OD 12	About 98 m.	5.35-6.0 p.m. (see conditions)		About 6.20 p.m.	,, ,,	Someone had a buzzer tuned to receiving set and swished round over 2 OD nearly the whole time.	——
24.10.24	2 SZ 5	101 m.	6.14-6.25 p.m.		About 6.20 p.m.	,, ,,	Bad night, QRM and QRN. Power leaks bad.	Windy and wet.
25.10.24	2 NM 42 2 SZ 27 2 OD 34	100 m. (95 m. later but was 100 m. at first) 99 m.	5.50-6.45 p.m.		About 6.10 p.m.	,, ,,	Good minimum QRN as QRM.	Dull but fine, no wind.
26.10.24	2 SZ 5 2 NM 8	97 m. 101m.	6.3 -6.35 p.m.		About 6.15 p.m.	,, ,,	QRN bad	Dull, showery and thundery.
27.10.24	2 NM 6	101 m.	6.14-6.40 p.m.		About 6.15 p.m.	,, ,,	QRM bad as usual	——
28.10.24	2 NM 8 2 KF 6-5 2 OD 7	101 m., about 97 m. 99 m.	6.5 -6.40 p.m.		About 6.15 p.m.	,, ,,	Night not much good for receiving. QRM.	Dull, N.E. wind.
29.10.24	2 NM 34 2 OD 25	101 m—98 m., about 99 m.	6.10-7.00 p.m.		About 6.30 p.m.	,, ,,	QRM from power leak at times and from land station (VLA).	Calm night, cloudy.
30.10.24	2 NM 15 5 LF 10 5 NN 9 2 WJ 12	Between 95 and 101 m.	6.20-7.17 p.m.		About 6.30 p.m.	,, ,,	Good night, QRN nil, until later.	Clear night, N.E. wind.
31.10.24	2 NM 23 2 KW 11 5 LF 16 5 NN 14	Between 95 and 101 m.	6.0 -7.00 p.m.		About 6.30 p.m.	,, ,,	Good night	——
1.11.24	2 NM 30 2 SZ 21	101 m. about 96 m.	6.10-6.40 p.m.		About 6.25 p.m.	,, ,,	QRN getting bad ..	N.E. breeze.
2nd	2 SZ 5 2 NM 12 2 OD 9	96 m., 101 m. about 97m.	6.5 -7.15 p.m.		About 6.25 p.m.	,, ,,	QRM valves	——
4th	2 NM 6	101 m.	6.20-6.35 p.m.		—	—	— —	——
9th	2 NM 4	100 m.	6.13-6.50 p.m.		About 6'15 p.m.	,, ,,	QRN	N.W. winds first, cloudy, then S.W. wind, been very hot all day and now changed again to N.W.

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for a few days as relating to my work with England.

So far the signals from 2 NM are the most consistent and the others following in order are G 2 OD, G 2 SZ, G 2 WJ, G 5 LF, G 5 NN, G 2 SH, G 2 KW. The notes of G2 OD and G 2 WJ are the steadiest and easiest to read.

I am glad my signals were the first to be heard in England, and I was unlucky in not being the first to work, but I had the rotten luck to burn out one of the transformers the very day the first cable came, so was on reduced power, as I could not obtain another replacement till the next day.

Anyway, Z 4 AA deserves to be first to communicate with England, since he has not the same facilities as we have in the town as to power. He has a private installation and naturally his power is limited, but he is getting all he can out of it.

PHOTOGRAPHS BY WIRELESS.

In the recent interesting experiments in the wireless transmission of photographs between London and New York the apparatus at Radio House in London consisted of a transmitter only. A view of the receiver, as installed in the Radio Corporation's office in New York, is shown in operation in the accompanying photograph, General J. G. Harboard, President of the Radio Corporation of America, seen on the right, is an interested spectator. No doubt it will be possible, when suitable receiving apparatus has been installed in London, to carry out "two-way" transmissions of a very interesting kind.

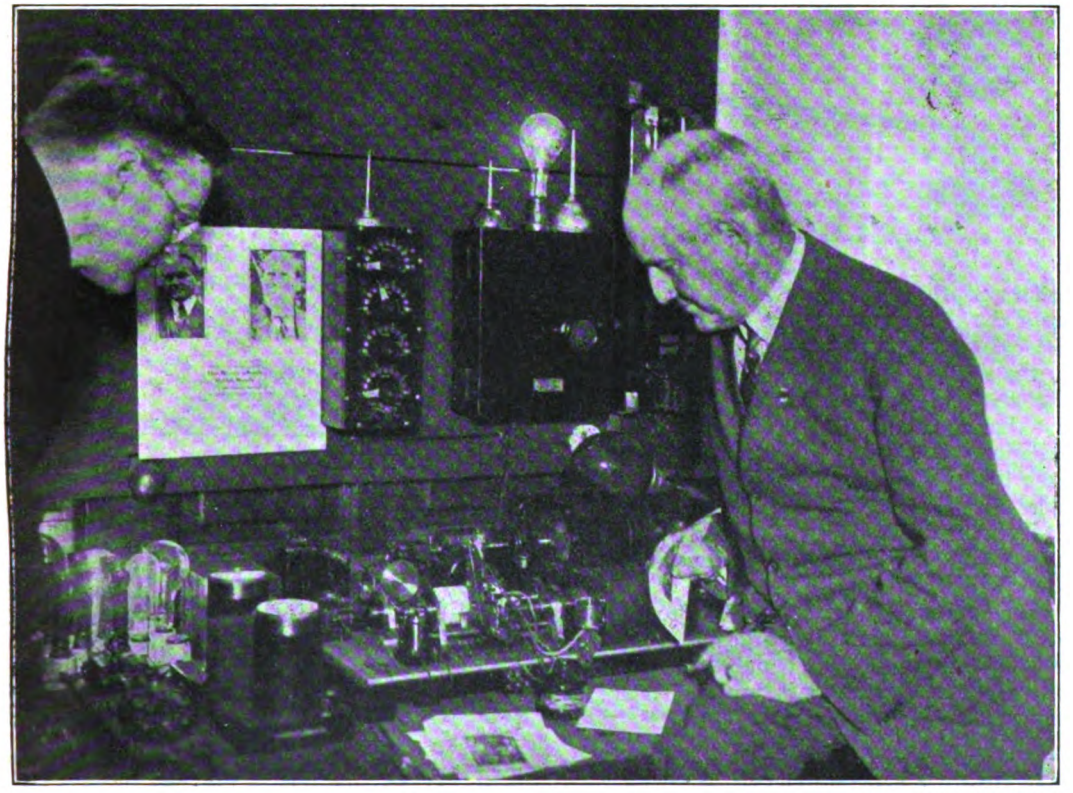

Photo: Kadel & Herbert.

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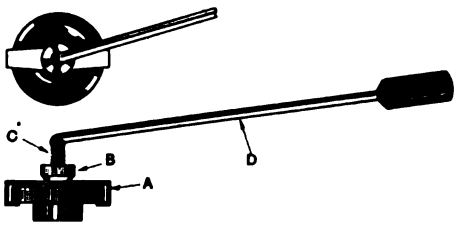
READERS' PRACTICAL IDEAS.

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Making an Anti-Capacity Handle.

EXPERIMENTERS troubled with hand capacity effects may find the following gadget of interest.



Useful extension handle.

The construction may easily be followed from the details given. It will be seen that the extension handle consists of a clip bent to the shape shown at A, so that it will grip the knob when the screw C is forced down by the action of the milled nut B. The bridging-piece A must be of sufficient thickness to take a thread so that B is in effect a lock-nut. The arm D is soldered to the end of the 2 B.A. screw, and if it is inserted into a slot or tapered into a hole, a strong joint will be produced.

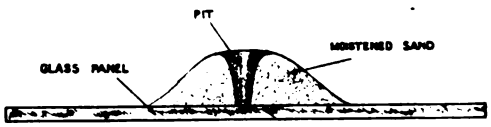
The ebonite handle is attached to the end of D and may be of a suitable length to entirely eliminate the capacity effect produced when the hand is brought near the instrument for adjustment.

E. A. D.

"Drilling" Glass.

MANY experimenters would like to make their instrument panels of glass, which, in addition to possessing good insulating properties, would enable the various component parts to be seen. The process of drilling the necessary holes may not only be very tedious but it will require a certain amount of skill and there is always the chance that the glass may fracture when the work is nearly completed.

An alternative process for making a limited number of holes is as follows. Obtain a handful of sand, moisten it with warm water and place a heap on the panel over the spot where the hole is desired. Then with a pencil make a small pit in the centre of the sand, as shown in the accompanying illustration. A small quantity of molten solder is now poured into the pit and owing to the rapid and local rise in temperature produced, it will usually fracture the



Making a hole through a pane of glass.

glass, leaving a clean hole. It is even possible to make square holes by suitably shaping the bottom of the pit. It would, of course, be as well to try this method on a few pieces of scrap glass before practising on the actual plate and the writer thinks that the "knack" of how to proceed will soon be learned.

R. S. R.

A Valve Mounting of Low Capacity.

THE capacity presented between the electrodes of the valve is sometimes added to by using a valve holder of poor design. A good method of reducing valve holder capacity to a minimum consists

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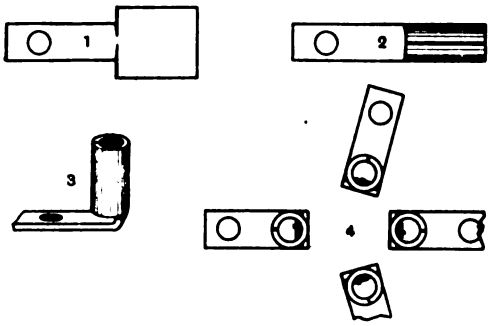
of making up suitable tubular tags from sheet brass and mounting them on a piece of good ebonite. Fig. 1 shows the brass suitably cut to shape, whilst in Fig. 2, the wide end



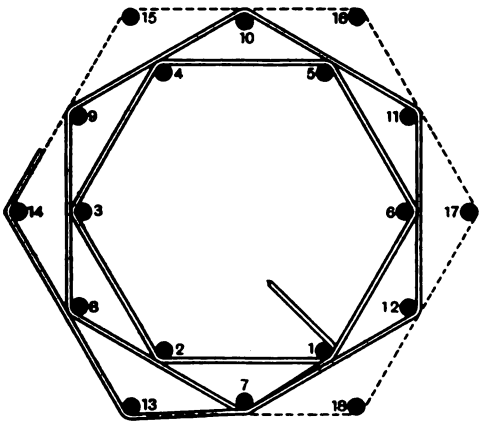
A low capacity valve holder.

pieces have been bent round to produce a tube which will securely grip the valve stem. Fig. 3 shows the tube bent up, while in Fig. 4, four pieces are mounted to form the valve holder.

T. C. S.

A New Method of Winding Tuning Coils.

A TUNING coil possessing very low self-capacity can be constructed as follows. Twelve french nails are driven into a block of wood in the positions as shown and



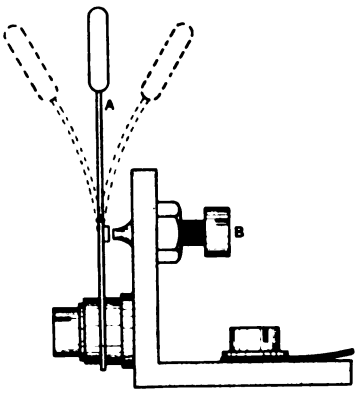
Method of winding tuning coil of low self-capacity.

numbered 1 to 12. Using No. 22 D.C.C. wire, winding is commenced round the first row of nails, the turns being put on side by side to the required depth. A second layer is wound around the second row numbered 7 to 12 to the same depth as the first layer. The coil is then shellaced and removed when hard. A two-layer coil with 14 turns per layer and shunted with a variable condenser having a maximum value of 0·0005 μF tunes over the broadcast band of wavelengths. Additional layers may be put on as shown by the pegs 13 to 18. The complete coil can be easily mounted on a standard plug.

A. R.

A Reliable Buzzer.

A BUZZER making use of an electro-magnet to operate the armature usually suffers from the defect that the contacts stick and are difficult to adjust.



A buzzer that never fails.

A buzzer which will never refuse to work can very easily be made up by mounting a short piece of steel spring in front of a battery contact. In the accompanying diagram this contact is shown attached to the screw B, which is threaded through the upright piece and held firmly by a locknut. A piece of steel spring is also carried on the upright but is insulated from it by means of an ebonite bush. This piece of spring carries a small leaden weight A and it is only necessary to apply a sideways pressure to A and release it to set the buzzer in operation. A buzz having a duration of 30 seconds is easily produced and is usually quite sufficient for making a simple tuning adjustment or to effect the setting of a crystal.

E. L.

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THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

Types of Oscillator for a Superheterodyne Receiver.

IN the last issue of this journal I outlined the principles underlying the operation and design of a superheterodyne receiver. The reader will remember that a local generator of oscillations is coupled to the grid circuit of the first detector, and that when the set is employed for the reception of continuous wave signals a second oscillator is employed. The second oscillator is usually coupled to the grid circuit of the second detector. When receiving telephone signals this second oscillator is not required.

The local oscillator may, of course, comprise a valve associated with suitable circuits forming part of the complete receiver, or one may employ a distinct unit which is coupled to the receiver when required. No doubt many readers will prefer to employ an oscillator designed to be a separate unit. Then it may be coupled to the superheterodyne receiver when desired, or it may be used as a heterodyne wavemeter which is suitable for use with a transmitter or receiver, and for other purposes—for instance, testing coils and condensers.

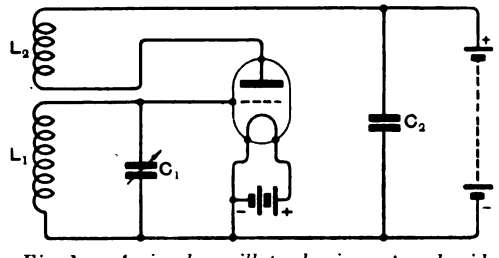

Fig. 1. A simple oscillator having a tuned grid circuit and a reaction coil

There are, of course, several satisfactory methods of connecting a valve to operate as an oscillator. Two usual schemes are given in Figs. 1 and 2. In Fig. 1 the anode circuit comprises the H.T. battery (shunted by a large fixed condenser, C_2), and the coil L_2. The grid circuit contains a coil L_1 and tuning condenser C_1. When the circuits are completed and coils L_1 and L_2 are brought together, oscillations will be generated provided the coils are suitably connected, and the frequency or wavelength of the oscillations may be varied by adjusting the tuning condenser C_1. Oscillations will not be generated if the

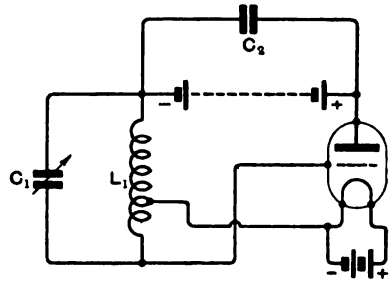

Fig. 2. Another oscillator which differs from that of Fig. 1 by employing a tapped coil with a tuning condenser connected right across it.

filament current is too low, if the voltage of the H.T. battery is too low, if the tuning condenser C_1 is too large, if the coil L_2 is wrongly connected with regard to coil L_1, or if these coils are too far apart. A simple method of finding whether or not the valve is oscillating is by watching a milliammeter connected in the anode circuit (between the filament and negative H.T.). When the valve is oscillating the anode current falls when the grid is touched with the finger. By employing a milliammeter in this way it is possible to determine with ease and accuracy the best values for the anode coil, H.T. battery and filament current; there is also a best degree of coupling of coils L_1 and L_2.

With some valves it is advisable to employ a grid condenser and leak; on the other hand results are generally quite satisfactory when the simple circuit of Fig. 1 is used as given. I have found that good results

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are obtained by using a D.E.R. valve, a 2-volt accumulator for heating the filament, and an H.T. battery of 30 volts.

The band of wavelengths tuned in by the oscillator of Fig. 1 is practically that which may be determined from a knowledge of the constants of the coil L_1 in the grid circuit and the tuning condenser C_1. The reaction coil, L_2, is usually smaller than the grid coil. It is therefore possible to tune over two bands of wavelengths by connecting the tuning condenser first across the grid coil L_1 and secondly across the reaction coil L_2. A simple change-over switch for altering the wavelength range could therefore be connected to the oscillator.

Further changes to the wavelength range can, of course, be made by changing the coils. In some instances they may be mounted together to form a single unit when all that is necessary to tune over a different wavelength band is to remove the coil unit in the oscillator and replace it with another unit containing coils of the required size. Alternatively the coils may be quite separate—being mounted, for instance, in the two plugs of a two-coil holder. This arrangement of coils is quite convenient in experimental work.

For suitable values of coils the reader is referred to the manufacturers' particulars of their tuning coils. To tune over 350 to 750 metres with a 0·0005 μF tuning condenser, for instance, a No. 75 coil could be employed in the grid circuit and a No. 50 in the anode circuit.

Another scheme of connection often employed is indicated in Fig. 2, where L_1 is the tuning coil and C_1 the tuning condenser. A large fixed condenser, C_2, is connected across the H.T. battery. It will be observed that the tuning condenser is connected across the whole of the coil, and that the filament is connected to a tapping on the coil. The most suitable position for the filament tapping should be found by experiment, but is often between one-third (from the grid end of the coil) to half-way along the coil.

To secure accuracy of calibration it is necessary to operate the oscillator always under the condition which obtained when the calibration was made. The wavelength changes as the filament current or H.T. voltage varies, and of course if the position or the constants of the coils change. If the oscillator is part of a superheterodyne receiver there is usually no need to employ instruments for indicating anode and filament voltages; but if the instrument is to be used as a heterodyne wavemeter where constancy of calibration is a first consideration, then it is advisable to take the precaution of setting the H.T. voltage and filament current to the values they had when the instrument was calibrated.

OSCILLATORS BEWARE!

A determined effort to rid the district of the bugbear of oscillation is being made by members of the Dulwich and District Wireless and Experimental Association. The accompanying photograph was taken on a recent evening when some exciting experiments were made with D.F. apparatus in an effort to discover the whereabouts of local "howlers." Frame aerials were employed with two mobile sets, and a number of bearings were taken.

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VALVE TESTS.

MULLARD D.06 VALVES.

WE have just completed our standard series of tests on some new Mullard valves sent us by the makers. Known as the D·06, these valves are of the "60 milliampere" type, and, in accordance with the policy of the makers, are issued in two forms: one for high frequency work and rectification (D·06 H.F.), the other (D·06 L.F.) for low frequency amplification only.

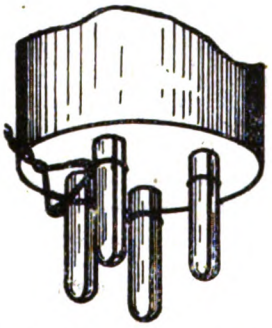

Fig. 1. Sketch of base of Mullard D.06 valve showing the wire link between the grid and filament pins of a new valve.

On taking these valves from their boxes it was noticed that a simple device has been employed which will prevent any used valve being sold to the public. This consists of a piece of wire connecting the grid and one filament terminal (Fig. 1), the ends of the wire being sealed. While therefore it is possible to test the filament for continuity, the valve cannot be used in a set without removing the short circuiting wire. We welcome any such innovation as it ensures the purchaser new and unused valves.

As to the valve itself it is to be noted that the new type of construction which employs the tunnel shaped anode has not been adopted in the D·06, the electrodes being similar to and mounted on the slant as in the D.F. Ora. The question therefore arises, are these new valves additional to or are they designed to replace the D.F. Ora? We incline to the latter view.

THE D·06 L.F.

Filament characteristics for the L.F. variety are given in Fig. 2, the current and emission at the normal voltage being ·071 ampere and 6·2 milliamperes respectively. This seems quite sufficient emission for ordinary purposes, such as for which the tube is designed, and the efficiency works out at 29 milliamperes per watt.

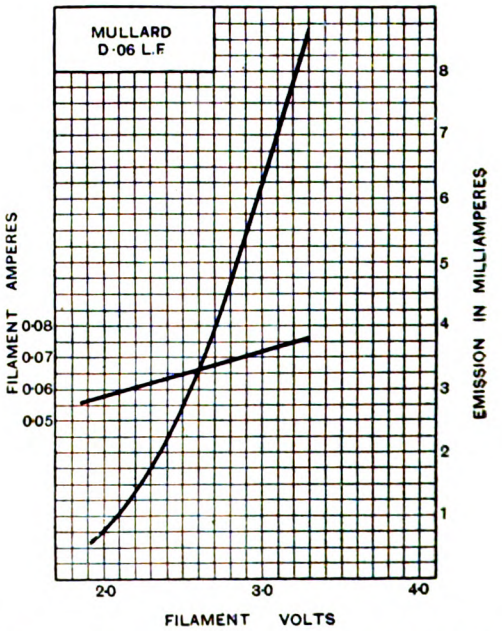

Fig. 2. Curves showing how the emission and filament current vary with filament voltage.

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The plate current characteristics in Fig. 3 are very suitable for the work the valve is intended to perform and a long operating range is afforded when the plate potential is raised to 80 volts. Saturation is commencing at zero grid volts, so that no useful purpose is gained by a further increase in plate potential. Actually subsequent tests showed that no material advantage was to

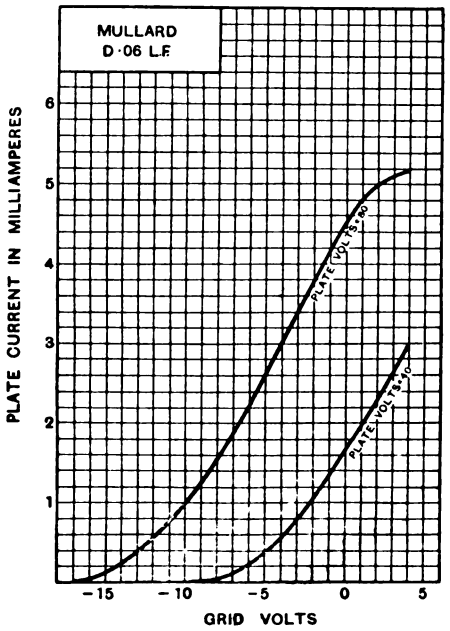

Fig. 3. Grid voltage-plate current curves.

be gained by using more than about 60 volts H.T. (See curve C, Fig. 4). The D·06 L.F. has a magnification factor of about 7, but varies slightly above or below this figure according to the H.T. The impedance at normal operating potentials is about 13,300 ohms. The effect of saturation is reflected in curve C, Fig. 4, which is seen to rise for plate potentials above, say, 65 volts. The dotted curve "D" shows the value of the plate impedance when the grid is set at −5 instead of zero, the latter grid potential being the one usually employed when determining the values for the impedance curve.

On circuit test the behaviour was such as would be expected from the curves already obtained. With 70 volts H.T. and a bias of −5 on the grid, we obtained excellent

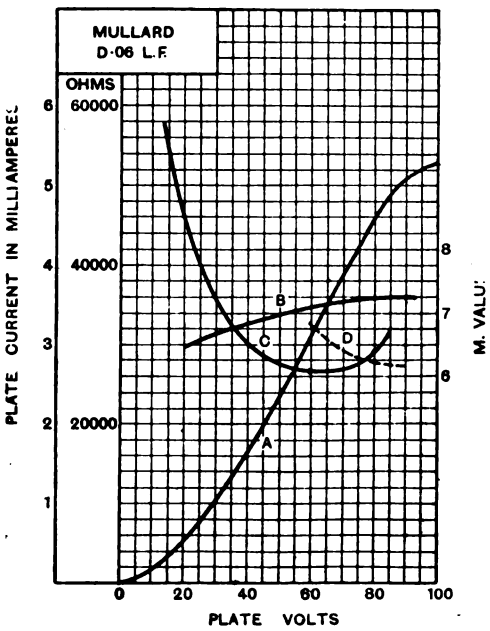

Fig. 4. Curves showing variation with plate volts of plate current (A), amplification factor (B) and impedance (C).

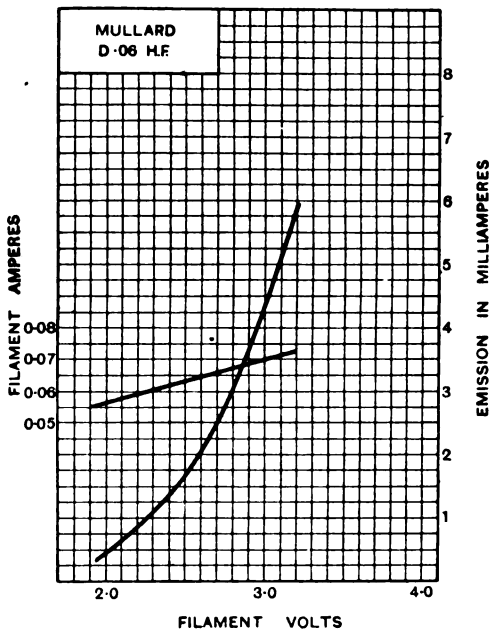

Fig. 5. Curves showing how the emission and filament current vary with filament voltage.

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results and provided the set was not forced, no distortion was noticeable.

THE D·06 H.F.

The curves relating to this valve are given in Figs. 5, 6 and 7. The emission at normal voltage was slightly lower than in the previous case, but was nevertheless quite sufficient for H.F. work. Actually in the valve under test it proved to be 4·25 milliamperes.

The two sets of plate current curves illustrated in Figs. 3 and 6 should be compared for they differ very considerably and it will at once be recognised that the H.F. type has a much higher magnification factor and impedance. A comparison of Figs. 4 and 7 will also prove interesting. From the latter we find the magnification and impedance to be approximately 20 and 40,000 ohms respectively.

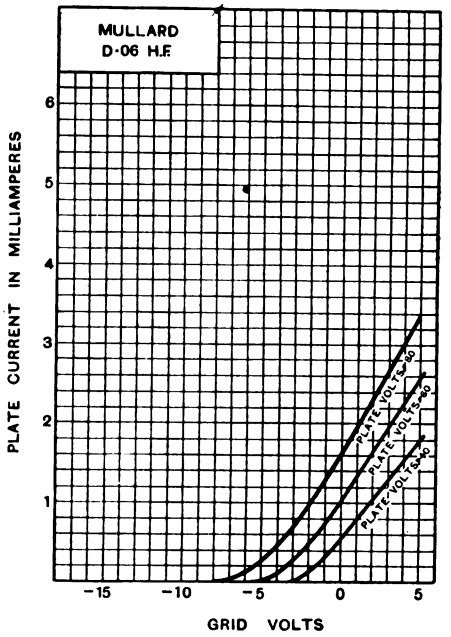

Fig. 6. Grid voltage-plate current curves.

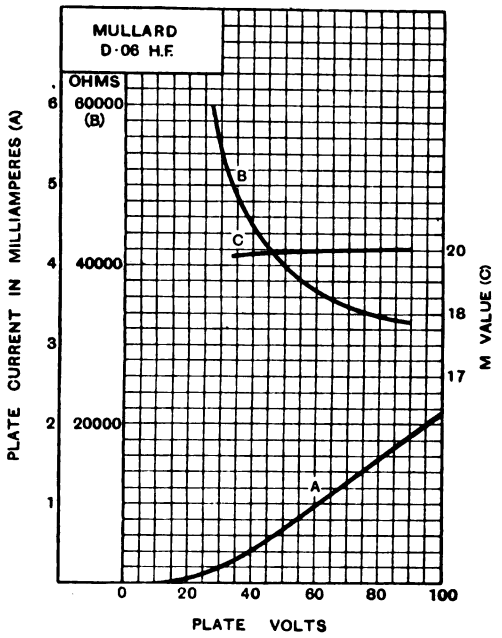

Fig. 7. Curves showing variation with plate volts of plate current (A), impedance (B), and amplification factor (C).

The results of our circuit tests were most successful; 50 volts plate potential appeared to be about the best to use although it was found that critical adjustment was not necessary.

Although we did not test for it, we incline to the belief that the H.F. type would most probably function very well in resistance capacity coupled circuits.

Finally, both of the valves under review may be considered as excellent examples of their class. It is interesting to note, however, that contrary to the design of the bright emitting single ring valves, the present ones are designed with widely different characteristics and they should therefore be better suited to the special work for which they are intended.

GERMAN-SOUTH AMERICAN WIRELESS SERVICE.

As the result of experiments on short wavelengths between Nauen and Buenos Aires, a regular ten-hour service has been opened between the two stations for the transmission of commercial messages on a 30-metre wavelength with a power of two kilowatts, says *The Times*. The most favourable period has been found to be from 10 p.m. to midnight. Further experiments are being made.

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STANDING WAVES.

This, the concluding instalment, gives the results of the wavelength measurements on a parallel wire system.

By GUSTAV LAMM and EDWARD GRAHAM.

(*Concluded from page 437 of previous issue*).

Fig. 7. (∝).—The wires as in Fig. 6. The wavelength was found as follows :—

Node 1 at (5·0845 ± 0·001) metres.

Node 2 at (10·1735 ± 0·001) metres.

The point of short-circuiting, A, must not be used because one is not able to fit its position with sufficient accuracy.

y = node 2 — node 1 = (5·089 ± 0·002) metres. K is 0·000785 for the corresponding wavelength and

λu_{∞} = (10.178 × 1·000785 ± 0·004) metres.

λu_{∞} = (10·187 ± 0·004) metres.

Thus the wavelength is determined with an accuracy of more than 0·4 %

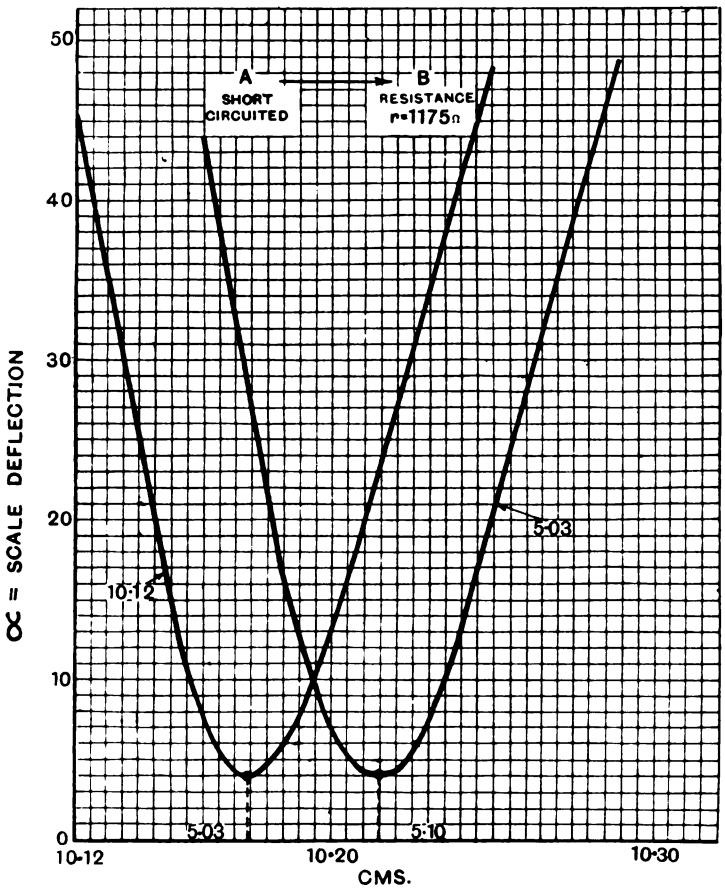

Fig. 7. Curves from which the wavelength may be found.

In most practical cases it will suffice to use the y value without corrections. The difference between the right value 10·187 metres and the value 10·178 metres, is only 0·009 metres.

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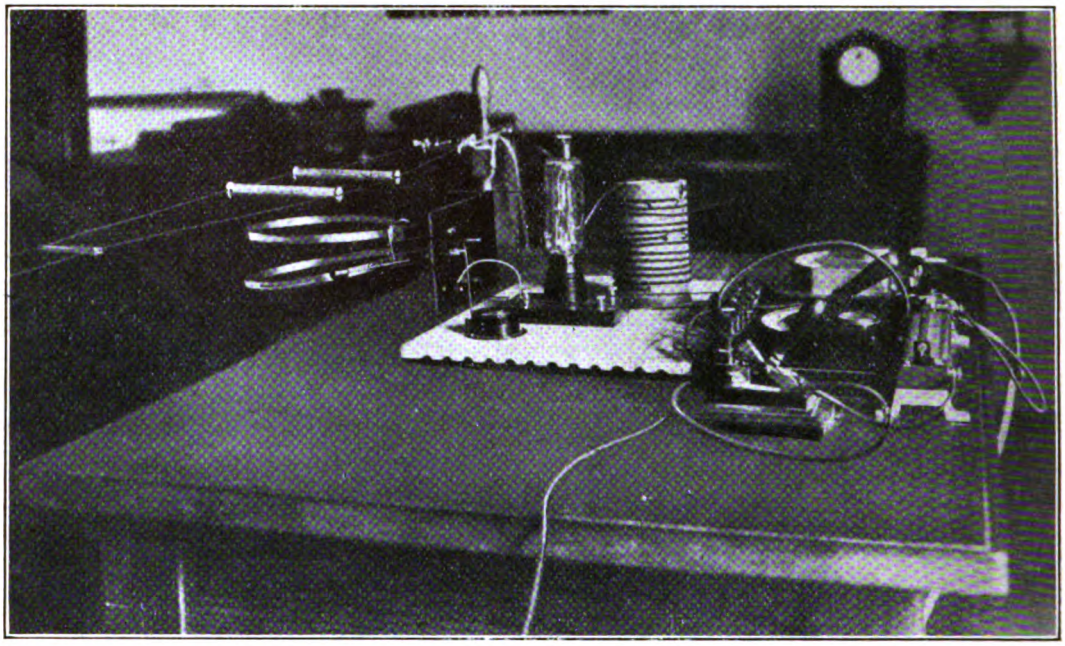

A view of the parallel wires and the valve generator of short wavelength oscillations.

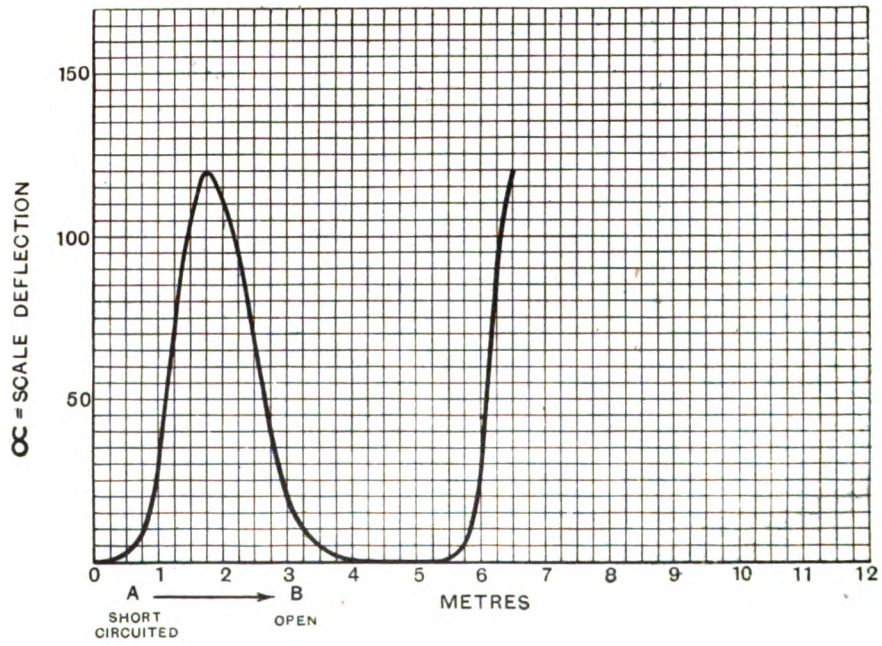

Fig. 8. The curves obtained when a valve voltmeter was employed.

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Fig. 8 (∝).—The wires as in Fig. 4.

The curve is obtained using the thermionic tube voltmeter, E, Fig. 3. Theory and practice coincide.

RESULTS.

If we compare the curves obtained with the thermo arrangements with the one obtained with the valve voltmeter we at once see the difference in their characteristics. The thermo-junction can be considered as having only resistance, but the valve acts as a capacity load. Here theory and practice go side by side.

We have further seen that we are really able to get any curve form at the measurements though we have induced a pure sine voltage upon the wires.

To secure very accurate wavelength values we have to proceed in the following manner: Method of measurement: vacuo-thermo-junction with millivoltmeter (M about 10), at A the wires should be short-circuited; between the B terminals we put in an electrolytic resistance with a value making the two maximum points per half-period equal and giving a symmetrical curve. The measurements should be taken at the nodal points where the accuracy may be, say ± 1 millimetres.

Now it is only necessary to make the theoretical correction according to the formula: $\lambda u_o = 2y\ (1 + K)$.

For practical purposes it is quite sufficient to use the valve method and measure the distance between two points of the same maximum voltage.

CORRESPONDENCE.

Reception of Zurich Broadcasting.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I read in your columns that the Zurich broadcasting station has been received in this country on two valves.

I have been receiving Zurich for about a month past on one valve with reaction, the plate current being supplied from the A.C. lighting mains (205 v.) *via* a rectifying valve. The strength is equal to all stations except 2 LO, Radiola, Brussels and Aberdeen, and the only thing which mars reception is the incessant jamming from broadly-tuned spark stations working on (nominally) 600 m. Despite the fact that only one valve is used there is no noticeable fading, and reception is possible on certain occasions in daylight.

I should be interested to know whether any other of your readers receive this station on one valve.

E. J. A. KENNY.

Dulwich, S.E.21.

A Tungar Rectifier Hint.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—For some years I have been using a Tungar Rectifier for charging batteries, and have found that after a certain number of hours (about 1,500), the charging current drops down to nil, despite the fact that the valve is unbroken. The rectifier I use is the tapped transformer type and I find that by raising the tap to one higher (230 v. to 210), current commences to flow again and continues to do so for about another 1,000 hours. The tap can then be raised to 190 v. with the same results. By this method I have succeeded in obtaining about 5,000 hours from a single bulb. The slight increase in input wattage is well worth the extra life. I think your readers using this type of charger may be glad of this tip.

RODNEY F. COSSER.

London, S.E.24.

Misuse of Call Signs.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have lately received various reports of reception of C.W., on about 125 metres, supposedly from my station 2 AS.

It is evident that some unauthorised person is making use of my call sign, as I neither use this wavelength, nor do the reported times of transmission agree with my log entries.

The matter has been reported to the competent authority, who is taking action, and perhaps the publication of this letter will also have the desired deterrent effect on the offender.

W. HARWOOD MOON (2 AS).

Penarth, Glam.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I see in your issue of November 26th, that Mr. Stanley Ward complains of the misuse of the call sign 2 QS. I should like to point out once again that my own call sign, 2 US, is frequently reported to have been heard in the Manchester area. It would appear that 2 US and 2 QS are both being misread, and that some transmitter in the Manchester area is either misusing one of these call signs, or fails to pronounce his own distinctly. During the last few weeks I have received an average of six reports per week, all from the Manchester district, of concerts transmitted on Sunday evenings.

Should this come to the notice of the transmitter concerned, I trust that he will endeavour to pronounce his call sign in such a way as will prevent confusion between 2 US, 2 QS and the correct letters. This has been going on for over a year now, and I cannot persuade myself that anybody would persistently misuse the same call sign for so long. If 2 QS's reports are all of Sunday transmissions my theory would appear to be confirmed.

J. F. STANLEY (2 US).

Highgate, N.6.

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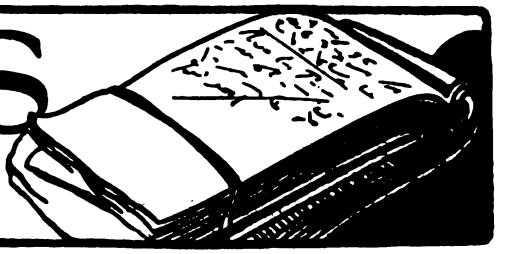
NOTES & NEWS



The Municipality of Vienna proposes to levy an entertainments tax on the Vienna Broadcasting Company.

* * * *

Four hundred accumulators belonging to listeners-in have been destroyed by fire at a re-charging plant in Carr Street, Stepney.

* * * *

NFF, the Hilversum broadcasting station in Holland, with a wavelength of 1,060 metres, is shortly to increase its power tenfold.

* * * *

A Post Office official states that although a special form of licence has been issued for broadcast reception at sea, only fifty have been applied for.

* * * *

The successful six months' test of the experimental wireless beacon at Nash Point, Bristol Channel, will probably lead to the erection of similar beacons round the coast.

* * * *

Captain Jackson, of the Moravian mission boat *Harmony*, states that the one wireless receiver in Labrador regularly picks up New York broadcasting, but cannot get the British programmes.

DX WITH MEXICO.

Two-way working with Mexican BX was established by Mr. E. J. Simmonds (2 OD) of Gerrard's Cross, Bucks, on December 19th at 7.15 a.m. The communication took place on 78 metres, and signals were received well at both stations. In the course of transmission, Mr. Simmonds sent the following message: "Greetings to Mexican amateurs from Radio Society of Great Britain." BX is the call sign of Mr. Harold Mapes, of Guanajuato, Mexico.

BELGIAN AMATEUR WORKS CANADIAN.

In the course of the Transatlantic communication tests, the Belgian amateur 4 YZ has succeeded in working with the Canadian C 1AR on two occasions, at 5.30 and 6.0 a.m. respectively. In the first attempt a power of 14 watts was employed by 4 YZ, which was increased to 20 watts on the second occasion.

NKF's SCHEDULE.

The short wave transmissions from NKF, the U.S. Naval Research Laboratory at "Bellevue," Anacostia, D.C., are continuing until further notice. These signals have been received by a number of British amateurs. The times given in the following schedule are given in Eastern Standard Time, which is five hours behind G.M.T.

54·3 metres.—Mondays, Wednesdays and Fridays, 8.0 to 8.10 and 9.0 to 9.10 p.m.

72 to 82 metres.—Mondays, Wednesdays and Fridays. 8.30 to 8.40 and 9.30 to 9.40. Exact wavelength will be announced during each test.

54.3 and 32 metres.—Simultaneous transmission, daily except Sundays, beginning at 10.0 p.m. working traffic with NPL.

Reports of the reception of these signals will be welcomed at the above address, and should include date, hour, and minute, wavelength, audibility, steadiness, presence or absence of disturbance and atmospherics, and weather.

COURSE IN A.C. WORK.

A useful course in "Alternating Currents and Electrical Oscillations" is to be given by Mr. D. A. Owen, B.A., D.Sc., F.Inst.P., at the Sir John Cass Technical Institute, Jewry Street, London, E.C.3. The course will consist of ten lectures, accompanied by practical demonstrations, and will be held on Tuesday evenings from 7 to 8.30 p.m., commencing Tuesday, January 13th, 1925. For residents in the administrative County of London, the fee for the course is 10s. Students under 18 years of age are admitted at half fees.

NEW AMERICAN BROADCASTING STATION.

The recent opening of KOA, the new broadcasting station of the General Electric Company at Denver, in the Rocky Mountains, was hailed with delight from all corners of America. According to reports received, congratulatory telegrams and telephonic messages were sent in within thirty minutes of the preliminary announcements from California, Chicago, New York, and Texas.

One of the most powerful of the American stations, KOA operates on Mondays, Wednesdays, Fridays and Sundays, on a wavelength of 323 metres.

PROPOSED FINNISH RADIO IMPORT DUTY.

The question of the construction of a wireless station at Helsingfors, has been under consideration by the Ministry of Communications of Finland. Some time ago the Finnish Government granted a concession for a station to an American, who, however, failed to obtain the necessary capital. It is thought that the best way to reorganise radiocasting in Finland will be for the Government to erect a complete station, with the view of later renting it to a private company which would take over the responsibilities of carrying on its operation. It is proposed that in order to defray the expenses

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of the station, the State should levy an extra tax of 10 per cent. of the value of imported wireless equipment and materials.

AMERICAN AMATEUR'S TRAGIC DEATH.

Radio station 6 CTE, states the News Bulletin of the A.R.R.L., permanently signed off the air the other night when its operator, Tom Banzhaf, went to his death while listening to the dots and dashes. Banzhaf, whose home was at 3,466 Twenty-first Street, San Francisco, died following an attack of heart strain before the headphones could be removed.

Banzhaf was an active transmitter, in spite of chronic heart trouble, and besides being the recipient of many QSL cards, 6 CTE had sent his own cards to amateurs all over the United States.

WIRELESS AND CAMELS.

A strange blending of the modern and the primitive is a feature of the journey to be undertaken from Angora to Mosul by a Commission of the League of Nations, appointed to establish the frontier between Turkey and Mesopotamia. The journey from Angora onwards, under escort of a strong Anglo-Turkish force, will be made on camels, while communication with the League at Geneva will be maintained by wireless.

BELGIAN AMATEUR DESIRES REPORTS.

M. A. L. Stainier (4 ALS) of 19 Boulevard de Tirlemont, Louvain, the Belgian amateur whose signals have frequently been heard in this country of late, would be extremely glad to receive QSL cards from British amateurs. All such communications are answered at once. M. Stainier is considerably increasing his power in the new year, and will work in the neighbourhood of 80 metres.

THE B.B.C.'s NEW HIGH POWER STATION.

The British Broadcasting Company's new high power station now under construction at Daventry will incorporate many interesting features designed to give a maximum power output.

Situated in open country, the site of the new station is 600 ft. above sea level, and nearly 400 ft. higher than the surrounding land. A "T" aerial will be used, and two masts are being set up 500 ft. and 800 ft. high respectively. The transmitter will be situated directly under the centre. In designing the antenna care has been taken to make the natural wavelength as near as possible to 1,600 metres, the station retaining the same wavelength as 5 XX. Although the power rating will be 25 kilowatts, the actual consumption on the station will probably reach 100 kilowatts. A novel earth system will be employed consisting of a circular

The new Marconi lifeboat set. Using a quenched spark transmitter, the installation has a range under normal conditions of 50 miles. The receiving gear includes a direction finder.

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metal plate laid underground, with a radius of 100 ft.

An overhead telephone line will connect the station with the London studio, and an underground cable will also be installed for emergency use.

It is claimed that the situation of the Daventry station will permit crystal reception within a circle of 100 miles. The first programme should take place in the spring. Transmissions will be made in the afternoon and evening, and the new station will provide programmes of its own twice a week, a provincial relayed programme on a third day, and relays of London programmes for the remainder of the week.

IDENTITY OF WGH.

Many readers have reported the reception of a short wave experimental station with the call sign WGH. The following information is contained in a letter from the American Radio Relay League, to Mr. John G. Gibson of Harrow.

WGY is one of the Radio Corporation stations located on Long Island, N.Y. This station has been transmitting "ABC de WGH" and other test signals for a number of months; it also appears to be handling some regular traffic. WGH is understood to be working on a power of kilowatts, on a wavelength of 107 metres. It is licensed to transmit on a number of wavelengths between 92 and 110 metres.

ADVICE ON TRANSATLANTIC RECEPTION.

British amateurs hoping to work on short waves with America, should at present confine themselves to the 95 to 98 metre band, according to the considered opinion of Mr. D. B. Knock (6 XG), who has recently met with great success in Transatlantic working.

In support of his advice Mr. Knock states that when working a short time ago with U 1BHM, on 102 metres, the American amateur reported bad disturbance from WGH at Tuckerton, whose wavelength is 105. "To go below 90 metres," says Mr. Knock, "is equally disastrous as local interference is very pronounced between 80 and 90 metres, so that an American amateur would find it next to impossible to sort out a weak signal from this side—out of the great number of Americans all calling CQ at once!"

U.S. AMATEUR'S TESTS.

Mr. J. L. Reinartz (1 XAM), the famous circuit designer, is transmitting a useful series of short wave signals from his station at 371 Hartford Road, South Manchester, Conn. A semi-automatic transmitter is used, and the following is the present schedule:—

25 metres.—Daily from 6.0 to 7.0 p.m. (E.S.T.).
55 metres.—Daily from 7.0 to 8.0 p.m. (E.S.T.).

Mr. Reinartz welcomes reports, which should be as complete as possible.

FINNISH 2 NCB.

If the Finnish amateur 2 NCB would be good enough to communicate to us his name and address, we should be glad to put him in touch with a British amateur who has heard his signals.

Radio Society of Great Britain

An ordinary meeting of the Society will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2., at 6 p.m., on Wednesday, the 21st January, 1925, when Sir Oliver Lodge, D.Sc., LL.D., F.R.S., the newly elected President of the Society, will deliver an address entitled "Matter and Radiation."

An informal meeting of the Society will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6 p.m., on Wednesday, the 14th January, 1925, when Mr. Stanley Ward will give a talk entitled "Some Notes on Short Wave Reception."

AN EXPERIMENT WITH ATMOSPHERICS.

That a number of the wireless problems awaiting solution can be tackled by the non-technical amateur was the theme of the Radio Society's talk from 2 LO, recently delivered by Mr. R. J. Hibberd.

A fortune awaited the man who overcame the problem of atmospherics, said Mr. Hibberd, and he proceeded to describe an interesting little experiment which could be carried out by all who were able to receive the transmissions of rhythmic scientific signals from the Eiffel Tower, transmitted nightly at 10 o'clock. The signals consist of a series of 300 dots formed by a single spark, and sound to the listener like the second ticks of a clock.

"The amateur or listener-in," said Mr. Hibberd, "should plot out these beats on a piece of graph paper beforehand. The second dots might be placed five small square intervals apart on the graph so that each square will represent one-fifth of a second. Now having prepared your graph chart, with pencil in hand, listen in immediately the time beats commence. Directly you hear an atmospheric make a line on your graph at the time and place at which it occurred. You would continue this procedure throughout the whole period of the time beats. Another point you must consider is whether the atmospherics are long or short in duration. If they are long you will make your pencil line long to correspond with its duration and if they are short your pencil line will, of course, be made proportionately short. A third observation may be attempted, and this is to denote whether the atmospheric is strong or weak. If strong, make your pencil line thick, and if weak make it thin.

By carrying out these three operations you will find approximately the time of the atmospheric, its length and strength. When the observations have been made a curve may be produced by joining the tops of the pencil lines, and from it you can deduce the periods when the atmospherics were similar.

"This little experiment may be carried out each night for a week, month or year, as desired, and when you come to sum up your results much useful information may be obtained. Those who wish to go more deeply into the subject might obtain the daily meteorological observations from the Air Ministry, who will post them daily to anyone in the United Kingdom for an annual subscription."

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AMONG THE SOCIETIES.

(Correspondence intended for Hon. Secretaries of Societies may be addressed c/o The Editor of this Journal.)

A highly satisfactory report of the year's work was presented at the Annual General Meeting of the City of Belfast Y.M.C.A. Radio Club, held on December 11th.

The activities of the members up to the beginning of the present session were primarily confined to the practical side of wireless, but during the winter special attention is being given to theoretical matters and an instructive series of lectures has been arranged.

* * * *

"The Construction of Broadcast Receivers," was the title of an instructive lecture delivered by Mr. F. H. Haynes before the Ilford and District Radio Society on December 9th. In the course of his remarks Mr. Haynes dealt comprehensively with the complete installation of a broadcast receiver, first giving attention to the aerial and earth system, and then describing the most suitable crystal and valve circuits. The elimination of distortion in loud speakers received careful attention, and the speaker advocated the use of resistance capacity coupling for securing the best results.

* * * *

The many kinds of rectifiers which are or have been in use in wireless were recently discussed before the Wimbledon Radio Society in a lecture by Mr. C. E. P. Jones. Among the many types mentioned were the chemical, vibratory, mercury vapour and the thermionic valve.

Mr. Jones's lecture was preceded by a reading of Captain Eckersley's lecture entitled "Faithful Reproduction by Broadcast," recently delivered before the Radio Society of Great Britain.

* * * *

With the object of initiating research work, members of the Manchester and District Radio Transmitters' Society have been asked to submit—(1) any recorded results from past experience; (2) any ideas which they would like considered; and (3) any abnormal and peculiar effects which he thinks may merit further investigation. This information is being collected by Mr. A. Simpson (5 BH), of 28 Westgate, Burnley, who requests that all data, which should be as precise and accurate as possible, should reach him by January 17th.

The Society is holding a dinner on January 20th at 7 p.m., and full particulars can be obtained from the Hon. Secretary.

* * * *

"The Principles Governing the Action of Crystal Receivers" formed the title of an interesting talk and demonstration recently given before the City of Belfast Y.M.C.A. Radio Club by Mr. John Wylie, B.A. The speaker gave a concise explanation of inductance and capacity, and proceeded to outline the principles of tuning. An instructive demonstration was given to show how the crystal acts as a detector.

* * * *

At the annual general meeting of the Bristol Centre of the Radio Society of Great Britain reference was made to the rapid growth of the Society during recent months. It is still felt, however, that many more members are needed. New members can attend the special lectures on wireless now being given at the Merchant Venturers College, in addition to other lectures and demonstrations at the University. Among the officers newly elected at the meeting were Mr. R. Hodge, as Chairman, and Mr. J. R. C. Murray, B.Sc., as Hon. Secretary.

* * * *

A successful exhibition of wireless and scientific apparatus was organised by the Peckham Radio Research Society at a sale of work held in St. Luke's Parish Hall, Peckham, on December 12th and 13th. More than 141 exhibits were staged, mostly the handiwork of members, and included a four-valve wireless receiver, various transmitters and numerous crystal receivers. Messrs. Alfred Graham & Co. kindly lent the Society a power loud speaker which was used to address the audience in the main hall.

An interesting lecture on "Dynamos and Motors" was given by Mr. R. M. Dougan on December 17th, and was followed by a discussion on insulation, especially in regard to short wave work.

FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 7th.

Institution of Electrical Engineers (Wireless Section). Ordinary Meeting. At 6 p.m. (light refreshments at 5.30). At the Institution, Savoy Place, W.C.2.

Radio Research Society, Peckham. Lectures: "Electrical Measuring Instruments," "The Dynatron."

THURSDAY, JANUARY 8th.

Bournemouth and District Radio Society. Visit to Bournemouth and Poole Electricity Supply Co.'s Works.

Luton Wireless Society. Lecture by Captain P. P. Eckersley, M.I.E.E. (Chief Engineer of the B.B.C.).

FRIDAY, JANUARY 9th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Department of Applied Science, St. George's Square. Elementary Lecture: "The Valve." By Mr. Watts.

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BROADCASTING.

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STATION.	CALL SIGN.	WAVE-LENGTH.
Chelmsford	5 XX	1,600
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Newcastle	5 NO	400
Bournemouth	6 BM	385
Manchester	2 ZY	375
London	2 LO	365
Cardiff	5 WA	351
RELAY STATIONS (on Low Power):		
Leeds-Bradford	2 LS	346
Plymouth	5 PY	335
Hull	6 KH	335
Dundee	2 DE	331
Edinburgh	2 EH	328
Nottingham	5 NG	322
Swansea	5 SX	318
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Stoke-on-Trent	6 ST	306
Sheffield	6 FL	301

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Radio Paris	—	1,780
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GERMANY.

Koenigswusterhausen (Sundays only)	—	2,800
Berlin	—	505
Munich	—	485
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GERMANY—*continued.*

STATION.	CALL SIGN.	WAVE-LENGTH.
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SWEDEN.

Stockholm (Telegrafverkat)	—	440

SPAIN.

Madrid (Radio Iberica)	—	392

ITALY.

Rome (Union Radiotelephone)	—	425

SWITZERLAND.

Lausanne (weekdays)	HB 2	850
Zurich	—	515

AUSTRIA.

Vienna (Wien)	—	530

HUNGARY.

Buda-Pesth	MT 1	950

CZECHO-SLOVAKIA.

Prague	—	1,150
Kebly	OKP	680

IRREGULAR PROGRAMMES AND TESTS ARE BEING TRANSMITTED FROM THE FOLLOWING STATIONS:—

GERMANY, Hanover 296 m. **HOLLAND, Amsterdam** PCFF 2,125 m. **SWITZERLAND, Geneva** HBI 1,100 m. **DENMARK, Copenhagen** 470 m., **Ryvang** 1,025 m. **SWEDEN, Gothenburg** SASB 290 m., **Boden** 2,500 m., **Malmoe** SASC 270 m. **ITALY, Centocelle** ICD 1,800 m. **SPAIN, Madrid (Radio-Espana),** 335 m., **Barcelona** 325 m., **Seville** 350 m. **CZECHO-SLOVAKIA, Komarov** OKB 1,800 m. **JUGO-SLAVIA, Belgrade** 1,650 m.

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READERS PROBLEMS

Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

INTERFERENCE FROM ELECTRIC LIGHT MAINS.

MANY readers have written complaining of humming noises in their receivers, due to various causes, such as near-by electric light mains, tramways or electric motors in near-by shops or cinemas, and have asked us to suggest remedies.

In a number of cases we have noticed that readers state that the noise is caused by a motor on their own premises. In this case, of course, the trouble may be attacked at its source by making sure that the framework of the motor is earthed, completely screening the motor with metal and experimenting with condensers of large capacity across the brushes, as the commutator of a D.C. motor is a frequent source of trouble in this respect. In the case of interference from near-by cinemas, it would be well if amateurs in the neighbourhood who suffer from this nuisance could get into touch with each other with a view to approaching the cinema management collectively on this matter, as much could be done if the cinema authorities could be induced to have their apparatus inspected by a competent electrical engineer.

There are several remedies, however, which can be tried at the receiver end. The more commonly recommended of these is, of course, connecting the cores of the low frequency transformers either to earth or in some cases even to H.T. positive, completely screening the receiver in a metal case, etc., whilst of course care should be taken to see that neither the aerial, lead-in, or earth wire runs parallel to or near to any electric mains.

In very many cases, however, which have been brought to our notice, the interference has been caused not by induction but by earth currents, and in nearly every case this can be cured by dispensing with the use of an earth connection and employing a counterpoise instead. Of course, we realise that in very many cases the amateur has not the necessary space at his disposal for the erection of a counterpoise under his aerial, but this need not deter any one from attempting to eliminate humming noises in this manner, as often if a length of covered wire 30 ft. or so in length is attached to the earth terminal and just led away anywhere, either round the skirting board of a room or outside the house (the far end not being attached to anything), the humming will be found to be conspicuous by its absence, and possibly a great deal of crackling noises hitherto attributed to atmospherics will be found to have disappeared also, and in a very large number of cases it is found that signals are stronger and greater distances can be achieved than when the earth connection was used. The reason for the latter is probably because the distance between the earth terminal of set and the earth was far too long. In a large number of cases where dwellers in an upstairs flat make use of a water-pipe as the earth connection, better results can be obtained by attaching 30 ft. or thereabouts of insulated wire to the earth terminal of their set, and either hanging it out of the window or placing it round the room. Another remedy which is sometimes effective in eliminating these extraneous noises is to place a condenser of large capacity, say 2 μF in the earth lead. Tuning will not be greatly affected by this, as the capacity of the condenser is very large. The use of a counterpoise is, however, usually more efficacious.

THE BALANCED CRYSTAL METHOD OF OBTAINING SELECTIVITY.

A READER has sent in a number of queries concerning the balanced crystal method of reception. He asks whether it is possible to obtain increased selectivity and elimination of atmospherics by this method, and also asks us to give a brief technical explanation of the principles involved in this method of reception.

In order to make use of this method of reception, it is necessary to employ two carborundum crystals, each having independent potentiometer control. The use of carborundum crystals has been greatly neglected by the average crystal user since the advent of broadcasting. Usually their sensitivity is not so great as is that to be obtained with the galena-catwhisker combination, but they have the advantage that, once set, they are extremely stable and not likely to be thrown out of adjustment by vibration or the accidental jarring of the table on which the receiver stands, as a flat steel plate pressing very firmly on the top of the crystal is used instead of a catwhisker. If greater sensitivity is desired, a steel needle, adjusted with firm pressure and not lightly as with a catwhisker, may be used instead of the plate, an ordinary gramophone needle being excellent for this purpose. We illustrate on next page a suitable circuit for balanced reception, alternative steel-carborundum or galena-catwhisker combinations being made available by switch S3.

In order to obtain a rectification effect with the carborundum crystal, we make use of the well-known fact that the asymmetrical conductivity properties of this crystal become very sharply

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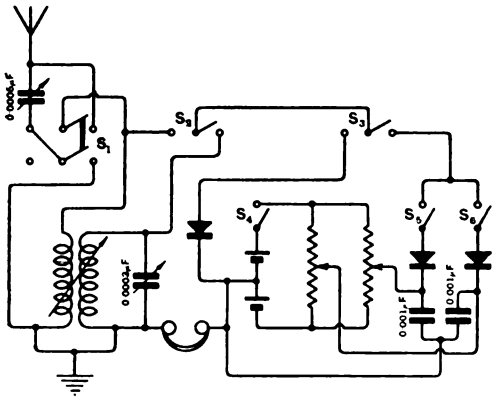
defined when a certain critical potential is applied to it. If a potential is applied to this crystal and gradually increased, the current increases very slowly indeed until a certain critical point is reached where the current increases enormously with a very small change of voltage. As the voltage is increased further, a second critical point is reached where the increase of current in respect of voltage increase again falls to a very low value. The normal potential of the crystal is adjusted critically on the sharpest portion of the lower bend of the characteristic curve, It is then obvious that one half cycle of the oscillatory potential set up across the tuning circuit by the incoming signal adds itself to the normal applied voltage, and since this is adjusted on to the lower bend, a great increase in the normal current flowing through crystal and 'phones is brought about, whilst the second half cycle produces a very minute decrease in the normal current. Thus rectification is accomplished; the sharper the bend of the curve, the more efficient is the rectification obtained.



A circuit using balanced crystals for eliminating interference.

When using the balanced crystal method for obtaining selectivity, it is possible for weak incoming signals to be read through stronger ones on exactly the same wavelength; in fact, the stronger signals can be almost entirely eliminated and the weaker ones only can be heard in the telephones if careful adjustment is made by means of the potentiometer. In the ordinary methods of obtaining selectivity by means of the tuning elements of the circuit, it is only possible to eliminate unwanted signals provided that their wavelength differs from that of the ones it is desired to receive. Using the balanced crystal method it is also possible to conisderably reduce the strength of atmospherics in proportion to weak signals.

In order to make use of balanced reception, two carborundum crystals are used, each having separate potential control. The two crystals and their respective steel plates are placed the opposite way round to each other in the circuit, so that when they are both individually adjusted, so that their normal potential comes on the lower bend of their respective curves, it is obvious that no rectification can take place, as when one half cycle is causing a slight decrease in the normal current through one crystal, it is causing a large increase in the current through the other crystal, and the result is, of course, that although rectification takes place at each individual crystal, no rectification effect is felt in the external circuit, due to the fact that the two crystals are rectifying in opposite directions.

Now suppose we slightly move the potentiometer of crystal No. 2, so that the normal potential of this crystal is slightly away from the lower bend, along the horizontal portion of the curve. It will be seen that we can obtain rectification of weak signals whilst stronger ones on exactly the same wavelength and also very strong atmospherics will be unheard in the telephones, as they will not be rectified. The reason for this is that although the potential of No. 2 crystal has been adjusted further along the horizontal portion of the curve away from the bend, yet strong signals sufficiently increase the normal voltage applied to this crystal, so that it is taken beyond the bend, and a large increase of current takes place through No. 2 crystal, whilst a small decrease is taking place through No. 1 crystal and *vice versa*, as before. In the case of weak signals, however, the extra voltage applied to No. 2 crystal by the incoming signal is not sufficiently large to carry it beyond the bend, and rectification is accomplished not by No. 2 crystal, which is known as the balancing crystal, but by No. 1 crystal, which is known as the rectifying crystal.

In practice switch S_3 should first be closed and the crystal associated with it adjusted carefully with the potentiometer, and then switch S_6 should be opened and the other crystal adjusted by closing switch S_6. Both crystals should now be switched in, and if correctly adjusted, no signals, or at any rate very faint ones, even from a near-by station, should be heard. Unless the crystals are exactly matched, it is of course impossible that their two rectifying actions be exactly balanced out. The crystal that shows the most sensitivity should be chosen for rectification, and the remaining one adjusted for balancing by moving the potentiometer slightly. In general it may be said that the less the difference between the volume of the unwanted strong signal or atmospherics and the desired weak signal, the less should be the movement of the balancing potentiometer.

The usual applied voltage does not exceed 1½ volts, and so a dry cell can be used. The circuit we illustrate shows two dry cells arranged so that up to 1½ volts positive or negative potential may be applied to each crystal, it being remembered that zero potential is obtained when the two sliders are in the centre and not at one end. Two small dry cells can be used, and will last several months, provided that battery switch S_4 is opened when the receiver is not in use. The potentiometers can be of 300 ohms resistance. Either of the carborundum crystals may of course be used separately by closing either switch S_5 or S_6 and adjusting with the potentiometer. As loose coupling can be employed, if desired, by means of switch S_2, the selectivity of this circuit should be very high, and by using suitable plug-in coils of the correct value, it should be possible to completely eliminate the local station and receive Chelmsford when quite close to the former. The circuit will be found remarkably stable and efficient.

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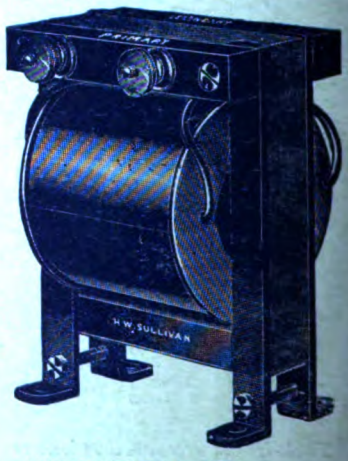

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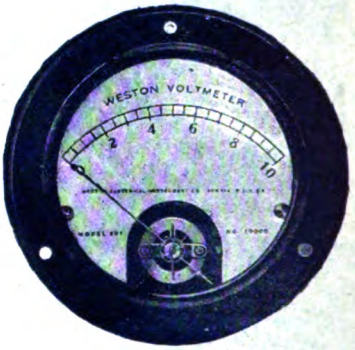

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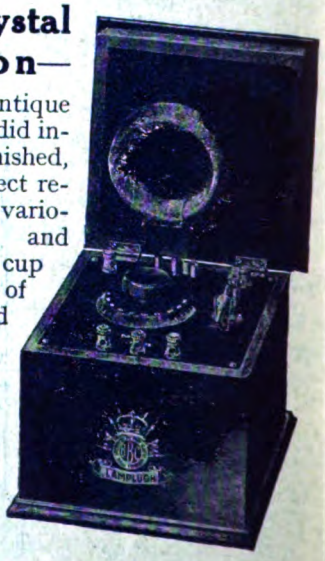

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

By THE EDITOR.

FOREIGN APPARATUS.

THERE are already indications that manufacturers of wireless apparatus abroad have not been slow to take advantage of the opportunity presented to them by the removal of the ban by the Postmaster-General on the use of foreign apparatus in wireless receivers, and agents are already active in this country taking steps to introduce components and sets of foreign origin.

As we have already mentioned in a previous issue, we do not think that the British manufacturer of high-class apparatus has any serious reason to feel uneasy at the prospect of competition from abroad, but it is those whose products are of a lower standard who are likely to feel the effect most keenly.

There will always be a good market for the best because experience and skill is required to produce first-class goods, whereas almost any manufacturer can put out products of inferior grade.

But we must not lose sight of the fact that America, for example, has had a longer experience of broadcasting than we have had in this country, whilst the conditions there have also been rather special in character. The number of broadcasting stations in America is very great, and in certain thickly populated areas there has been not only the question of oscillation of receivers to contend with, but the many broadcasting stations working with but very narrow wavelength spacing between them have brought about the necessity for special attention to be paid to the design of apparatus and receivers for obtaining selectivity. It is not so much in the quality of components perhaps that these conditions have shown their effect as in the special contrivances which are so numerous on the American market.

Considering the advance made by manufacturers in this country in other directions it is rather surprising to find how little serious attention has been paid to the problem of selectivity and mechanical devices to assist in fine tuning. Taking as an example the variable condenser, there are a few manufacturers in this country who provide a simple vernier adjustment or an additional single plate for a vernier control, but in America much more attention has been paid to the problem and the most popular device for very fine adjustment of variable condensers is to employ gearing to give a step-down ratio between the control knob and the spindle of the condenser, providing what is known as a slow movement dial adjustment.

Those who have used condensers of this type for precise tuning would probably never go back to other methods because of their convenience and the superior results which can be obtained from their use.

One has only to glance through the advertisement pages of an American trade wireless journal to appreciate how much attention has been paid to refinements in controls to provide accurate tuning adjustments and a comparison with the products of British manufacturers leads us to believe that this is one of the weakest points in our own apparatus when it comes to a question of competition with producers in the United States.

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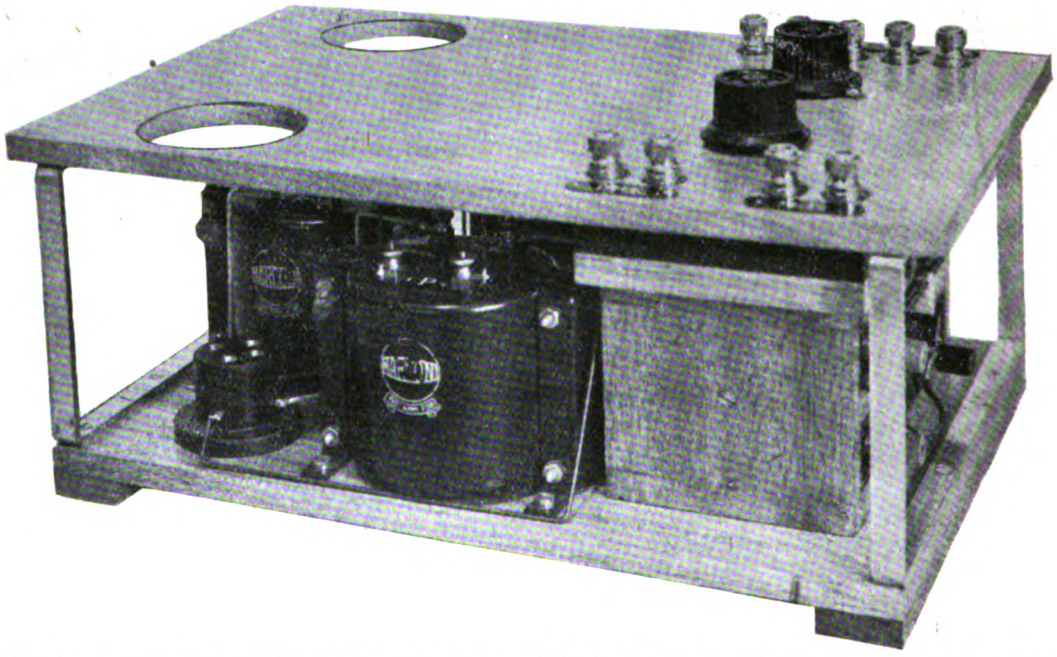

The two-stage power amplifier. The top wooden panel is attached by six 4 B.A. screws, and can be removed by releasing the grub screws in the filament resistance knobs. The end projections rest on battens across the cabinet.

BUILDING A

POWER AMPLIFIER.

Complete constructional details will be found for making up a high grade amplifier having two low frequency stages. The design can be copied by the beginner, and he will find that he will not come up against any difficult operations beyond his skill and requiring liberal workshop equipment, whilst the wiring layout will be found easy to follow. It will be seen that while certain high priced components have been used to ensure the best possible performance, wooden panels are employed to simplify the construction and economise in cost. Several new constructional features will readily be noticed.

By F. H. HAYNES.

FOR use after valve detection, this amplifier gives the necessary increase in signal strength for loud speaker work.

The circuit (Fig. 1) is a usual one in which the first valve is operated through an input transformer, and transformer coupled to the second valve, whilst an output transformer is used to feed the loud speaker so as to remove it from direct electrical connection with the high tension batteries and also to limit the current flowing through its windings. Each valve can be supplied with its requisite plate potential, and two grid batteries give the very necessary grid potential control. It is better to use separate batteries for each valve to avoid the coupling between the valve circuits which would occur should one of the cells become faulty and create a high resistance. If a high resistance path becomes common in the grid circuits of both of the valves low frequency oscillations will be set up and a continuous note will be emitted from the loud speaker.

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The parts required are—

2 Intervalve transformers, which, ordinarily, may have step-up ratios of 3 or 4 to 1.
1 Low ratio intervalve transformer for use as an output transformer.
2 Ashley filament resistances.
2 1 mfd. condensers with extension pieces for screwing down to the baseboard.
2 9-volt Hellesen's grid batteries with plugs.
9 Terminals with stems $\frac{5}{8}$ in. to $\frac{3}{4}$ in. in length.
6 ft. hard brass strip $\frac{3}{8}$ in. by $\frac{1}{8}$ in. This should be reasonably straight and free from kinks or abrasions.
3 ft. $\frac{3}{8}$ in. mahogany 9 ins. in width.
Piece of ebonite sheet $2\frac{1}{4}$ ins. by $3\frac{3}{4}$ ins. by $\frac{3}{8}$ in.
Small piece of $\frac{1}{4}$ in ebonite sheet, say about 2 ins. by 1 in.
2 Valve holders.
1 dozen 4 B.A. by $\frac{3}{4}$ in. cheese-headed brass screws, with nuts and washers for holding down the transformers (10 only required, and all other quantities of screws are slightly in excess).
2 dozen small connecting tabs (brass or tinned brass) for inserting under the transformer terminals, and connecting up to the L.T. distributing strip.

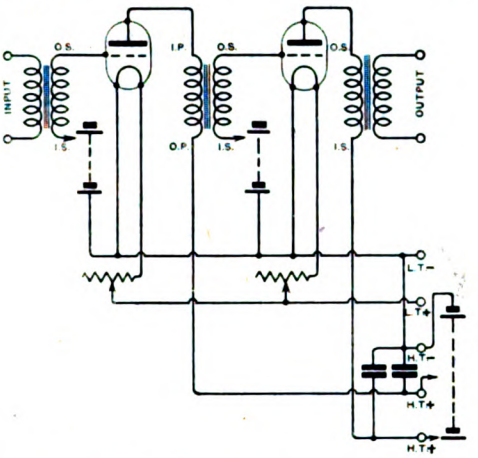

Fig. 2. Circuit of a transformer coupled low-frequency amplifier. Considerable amplification will be obtained, and should the loud speaker be overloaded, leak resistances of 0.25 megohms may be shunted across the secondary windings.

1½ dozen larger tags for inserting under terminal locking nuts and filament resistance connections.
1 dozen 6 B.A. by $\frac{1}{4}$ in. cheese-headed brass screws for securing tags to L.T. distributing strip.
2 dozen No. 4 by $\frac{3}{4}$ in. countersunk headed brass wood screws for attaching the

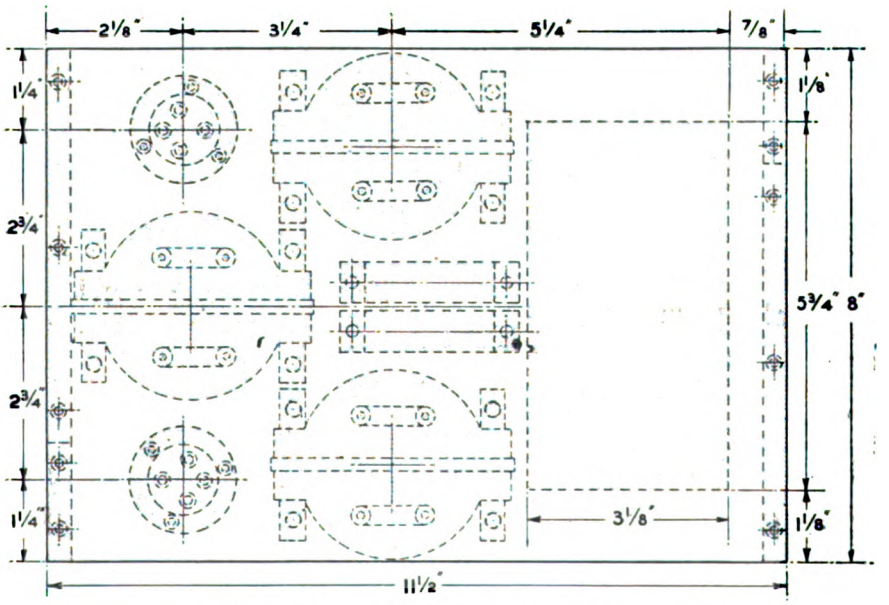

Fig. 1. Positions for assembling the components.

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brass rectangles to the base, and constructing the grid battery box.

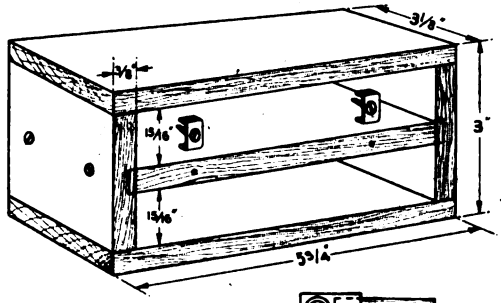
½ dozen 4 B.A. by ½ in. countersunk headed brass screws for securing top panel to the brass rectangles.

1 dozen nuts to fit terminal stems (2, 3 or 4 B.A.).

1 dozen countersunk headed brass wood screws, No. 4 by ⅝ in., for attaching the batten pieces.

½ dozen No. 4 by ½ in. countersunk or round-headed brass screws for attaching the valve holders.

1 dozen No. 4 by 1¼ ins. countersunk headed brass wood screws for attaching



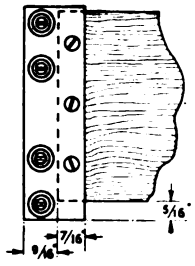


Fig. 3. Details for making up the grid battery box and terminal strip.

terminal strips and L.T. distributor piece.

Tack-on labels, "Input," "Output," "+ L.T. −," "+ H.T.−" and "+." The last-mentioned can be cut from a larger label.

4 10-ft. lengths of "Glazite" connecting wire in blue, red, yellow and black.

The wooden base panel is made up with the grain running along its length. This is quite easily done with a saw and a small plane, provided a good planed board is used exact to thickness. A pair of cross battens are fitted at the ends on the under side, made from the same wood and about 1 in. in width. After finishing with fine glass-paper both sides may be varnished or polished.

The small wooden box which houses the grid batteries is shown in Fig. 3. For simplicity the dividing piece between the two batteries is not shown with its ends let into

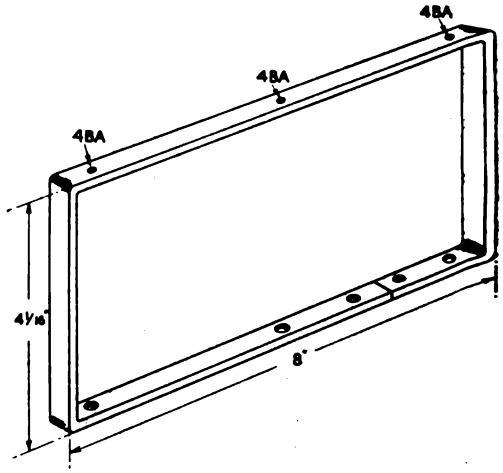


Fig. 4. One of the brass rectangular spacing pieces. Width ½". Thickness ⅛".

the uprights, though if a tenon saw and narrow chisel are available this may be done, as was the case with the actual set illustrated here. Working to the dimensions given, this box will accommodate the two

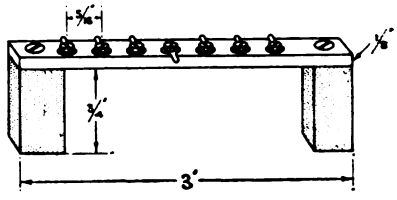


Fig. 5. The connecting bar of the leads running to L.T. minus.

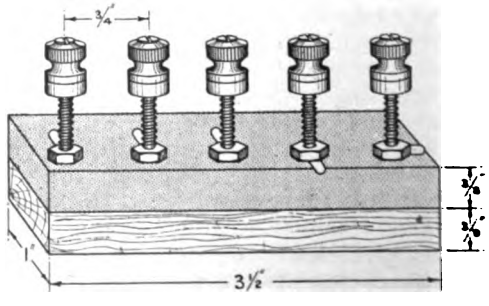


Fig. 6. Method of securing the elevated terminals.

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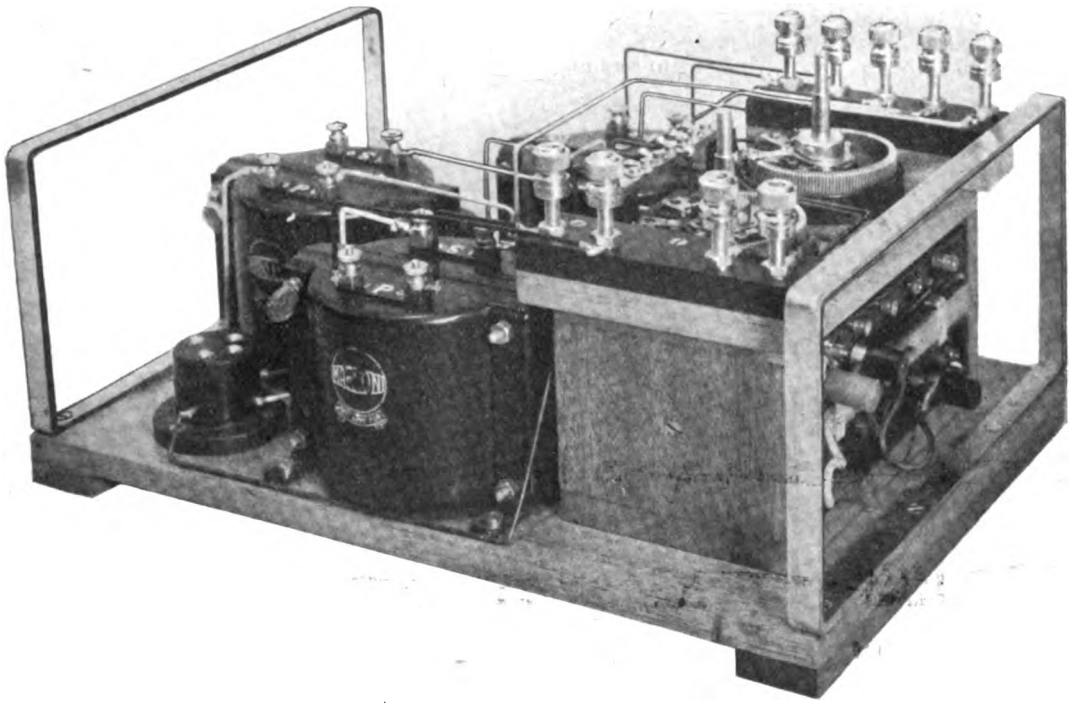
"Hellesen's" 9-volt batteries, and at the same time support the filament resistances at a suitable height, so that when the main top panel just covers the transformers the spindles of the resistances will suitably project. It also gives support to the terminals in the manner shown in Fig. 6. Holes are tapped right through the ebonite pieces and the terminals are prevented from turning by means of lock nuts, which also hold down connecting tags.

Attention may be drawn here to the fact that connecting tags are used throughout the entire set, which is a practice that should be adopted by every amateur in all his sets. It avoids the overheating of terminals and the spoiling of threads with solder, gives a good area of contact, and permits of ready dismantling.

A thin piece of wood ($\frac{1}{8}$ in.) or two thin cross strips should be attached to the back of the grid battery box to prevent the batteries falling through. Small brass or wooden stops may at the same time be made for clamping the batteries down in the box.

The brass brackets (Fig. 4) used to carry the top cover panel are made from $\frac{1}{8}$ in. by $\frac{3}{8}$ in. hard brass strip. Great care must be taken when bending to avoid a fracture. It is advisable to bend the brass while red hot, clamping it in the vice and hammering it over. Only a small bend should be made at first, and the rule applied to the strip to make sure the bend is taking place at exactly the required point. The four bends should be made to produce an overlap and the saw passed through at the joint. After drilling the holes and tapping those which are to be along the top, the brass should be polished bright with fine emery and given a protective covering of pale gold lacquer.

The use of these brass brackets can be avoided if thought to be too difficult to make up, by substituting a wooden piece at the valve holder end and two vertical pieces at the grid battery end, though it will be necessary, now, to fit cross battens to the



A side view showing the brass rectangular pieces, the grid battery box and the terminal supports.

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top panel to prevent it warping. Small brass angle brackets are obtainable with sides 1 in. in length by ⅜ in. wide by about No. 16 S.W.G. in thickness, and already drilled with four small countersunk holes.

make. A feature of the layout adopted is that the wiring leads are all short and direct.

With all components in position the wiring-up can be followed from the practical wiring diagram (Fig. 7). No. 16 tinned

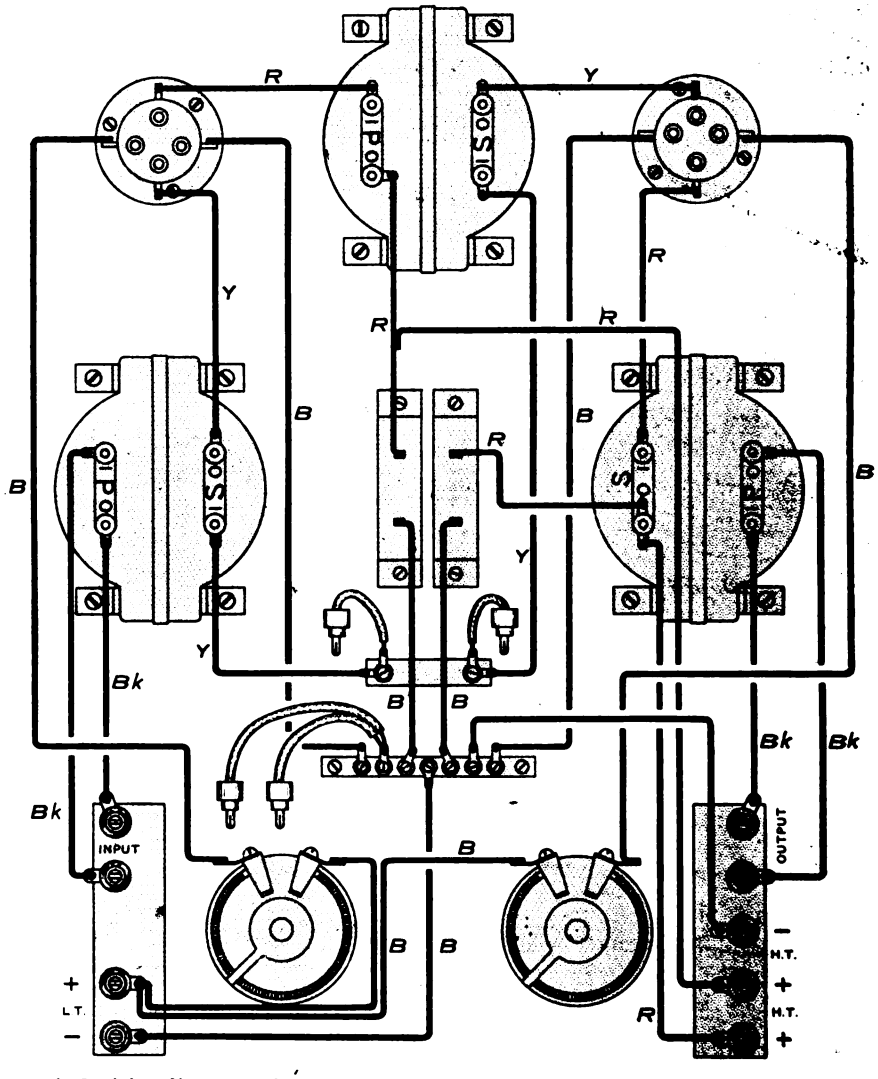

Fig. 7. Practical wiring diagram. The components are shown in their exact relative positions and the wires are run by the paths shown. The Glazite connecting wire does not permit of making "T" joints, and the L.T. connections are distributed from a strip of tags. Red, yellow, blue, and black covered leads are used, though the wiring may be rendered inconspicuous by using black throughout.

These can be used with advantage if wooden end pieces are adopted.

The layout of the components is shown in Fig. 1, and there is plenty of room for the inclusion of transformers of almost any

copper wire may be used, though in this instance the new "Glazit" wire was employed, which is about No. 17 S.W.G. tinned copper, with a glazed fireproof covering and obtainable in a range of colours.

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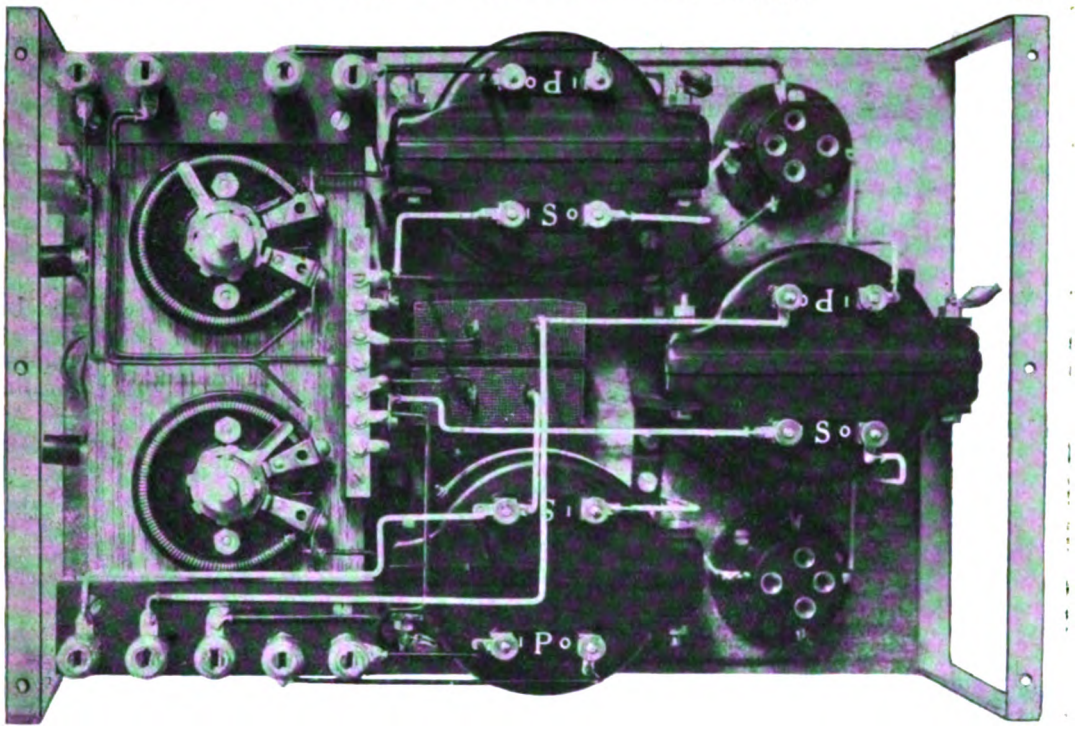

The wiring and arrangement of the components is here clearly shown.

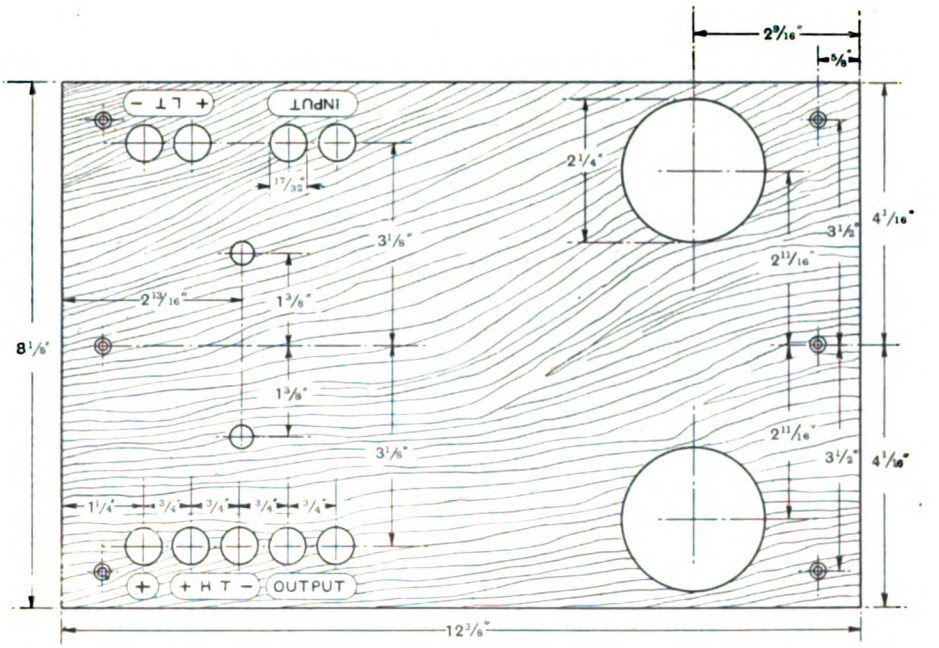

***Fig.* 8.** *Constructional details of the top wooden panel made in planed mahogany ⅜" in thickness.*

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This wire does not lend itself to making "T" joints, which is no disadvantage, as it is advisable in an instrument of this sort to distribute all leads independently, having no parts common to other circuits. For this purpose a small buss bar has been made up, and is seen supported by the grid battery box. This connects to all leads in the L.T. minus circuit, and makes a really nice job.

The cover panel is shown to scale in Fig. 8, with holes giving good clearance to the valves, and through which they can be inspected and at the same time affording protection. The terminals pass through clearance holes with their bases flush with the top of the set. It will be noticed that the cover panel is longer than the base carrying the components, so that when all is finished it may be inserted into a cabinet, and with its ends resting on fillets.

In operation one must take care to use suitable valves and adjust the grid bias very carefully according to the H.T. potential applied. The instrument was tested out with M.O. valves of the D.E.5 class, and gave very satisfactory results, though for really high power work when the grid potential of the last valve may be fluctuated over a very wide voltage range it is advisable to use a special power amplifying valve such as an L.S.5, for the final stage.

MAX HOWDEN (3 BQ), OF BOX HILL, VICTORIA, THE FIRST AUSTRALIAN AMATEUR TO EFFECT TWO-WAY COMMUNICATION WITH AMERICA.

Transmitting with an input of half a kilowatt on a wavelength of 86 metres, the aerial current is 0·9 ampere. An aerial 80 feet high, situated on the top of a hill is employed. On the left of the illustration is the receiver, and on the right the transmitter. A feature of the station is its simplicity. No elaborate apparatus is employed.

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SENSITIVE RADIO-FREQUENCY RELAY.

This article describes the theoretical properties, mechanical construction and possible application of a new electron relay, invented and developed by Samuel Ruben, a physicist of New York. This relay has been developed to control currents as great as five amperes by means of extremely small operating currents of any frequency.*

By GEORGE LEWIS.

THE operation of this relay is primarily based upon the employment of the kinetic energy of the thermionic discharges brought about by a suitable emission element, such as a filament, when directed upon a sensitively responsive anode. The impact of the electron stream upon the anode results in the expenditure of the kinetic energy of the bombarding stream, which is translated as:

1. A slight and negligible mechanical effect;

2. A negligible radiation of low wavelength and

3. A temperature rise of the anode.

Various valves have been constructed by Mr. Ruben, in which he has employed different anodes for the utilisation of the thermionic bombardment principle. As the temperature rise of the anode is the major effect in this type of valve, amounting to practically the entire translation of the kinetic energy of the electron stream, the anode adopted as the most serviceable is the thermo-sensitive type. (Figs. 1 and 2).

In the type of valve described below, the translated energy is employed as a means for operating the contacts of a relay situated within the valve.

The rapidity of the action of this device is dependent on the rate of heating and the rate of cooling of the anode, which, in turn, are dependent upon factors as follows:—

Rate of heating—dependent on:

(*a*) Power of bombarding electrons—this should be as great as possible.

(*b*) Heat capacity of anode—this should be as small as possible.

Rate of cooling—dependent on:

(*a*) Ability of anode to radiate power.

(*b*) Heat capacity of anode—this should be as small as possible.

In the device as now developed, the anode is composed of a blackened strip of nichrome which is initially maintained at a high temperature, in the neighbourhood of 600 deg. Cent. The strip form gives a large radiating surface with a small mass and therefore small heat capacity. The high initial temperature gives the anode increased ability to radiate power, since this depends on the fourth power of the temperature.

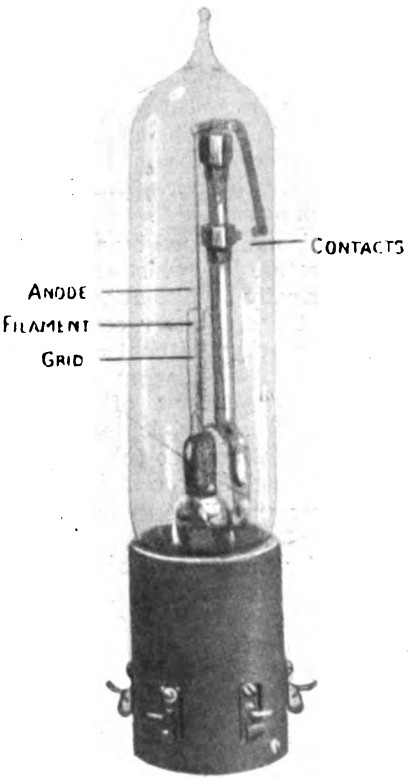

Fig. 1. *A view of the Ruben relay which clearly shows the construction.*

**Journal of the American Institution of Electrical Engineers*, Nov. 1924.

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This relay comprises four main elements:

1. A source of electron emission—a cathode;

2. A means for controlling the electron emission flow;

3. A sensitively responsive anode, and

4. A movable contact arm and a stationary contact for the control of a high-density external circuit.

The cathode element employed in this relay is a platinum-iridium strip having a newly-developed oxide coating which gives the cathode a high thermionic efficiency and a long life. The strip is suspended parallel to the sensitively responsive anode, which is composed of nichrome, attached at one end to the movable contact arm of the make-and-break device, controlled by the movement of the anode responding to the impact of the electron stream upon it. The electron discharge from the filament is electrostatically controlled by a grid element interposed between the filament and anode, so that in operation the grid controls the anode movement by virtue of its control of the electron stream.

The anode is maintained by a local circuit at a temperature at which the movable contact is normally at a point very minutely spaced from the stationary contact. Such close contact spacing, without any tendency to arc or spark, even when the external circuit carries a current of considerable potential, is made possible by the degree of evacuation to which the tube is subjected before the sealing-off process is completed.

As the necessary slight movement of the contact arm of the make-and-break device is controlled by the thermo-expansive anode of the described characteristics, the operating speed of the device is high compared with usual thermal devices.

To avoid any deformation of the elements of this device from the repeated application of high temperatures, especially in the process of evacuation, great care has been taken in their composition and design. The result is a notable stability of adjustment under operating conditions.

Nichrome was selected for the anode as it was found to possess the following desirable electrical and physical characteristics:

(*a*) Operating constancy over long and interrupted periods of use.

(*b*) High and constant values of electrical resistance at various operating temperatures;

(*c*) Suitable co-efficient of expansion and

(*d*) Adequate mechanical strength at operating temperatures.

The contacts of the circuit control device are composed of tungsten, one being affixed to a lever supported for the proper ratio of its arms. The lever and stationary contact support are composed of nickel-manganese, an alloy found suitable for vacuous devices. One end of the lever carries the tungsten contact, and the other is attached to the thermo-expansive anode.

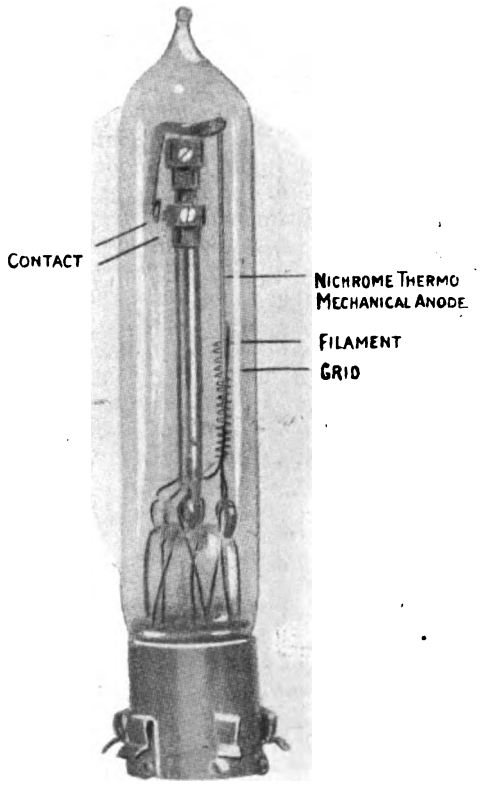

Fig. 2. Another view of the Ruben relay.

As the anode expands and contracts in response to the action of the controlling electron stream, the movable contact moves towards and away from the stationary contact, thus serving to close and open the external circuit.

The normal position of the lever can be made practically independent of the position of the apparatus itself, which can be mounted in a horizontal or vertical plane.

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The actual energy necessary to control the external circuit of high density is of very small magnitude, being only that necessary to electrostatically charge the grid element sufficiently to modulate the impacting electron stream, as in the present thermionic devices. The time required for the actuation of the lever is controlled by the heating current normally discharged through the anode.

CONNECTION OF RELAY IN CIRCUITS.

Fig. 3 shows a typical connection of such a relay into a circuit. In the circuit as shown the relay is operated by incoming radio signals, and controls a signalling device indicated as a call bell. The anode is so connected that its energising circuit is partially short-circuited when the contact of the relay circuit is closed, thus causing the anode to cool by radiation, and causing the circuit to open. By this rapid heating and cooling of the anode element the relay contact opens and closes the external circuit at a rate of about 20 times per second.

The relay can be employed in this manner as a call device for radio or carrier-wave circuits for either telegraphy or telephony. When used in this manner, all of its circuits can be supplied with energy from a single transformer as indicated

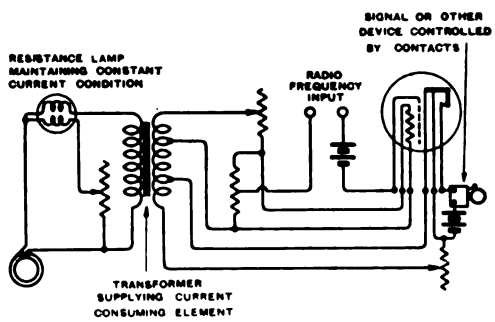
SIGNAL OR OTHER DEVICE CONTROLLED BY CONTACTS
RESISTANCE LAMP MAINTAINING CONSTANT CURRENT CONDITION
RADIO FREQUENCY INPUT
TRANSFORMER SUPPLYING CURRENT CONSUMING ELEMENT

Fig. 3. Connections of a relay operated by wireless signals.

To keep the adjustment constant and independent of line variations, a ballast lamp specially developed for this relay has been supplied. The lamp comprises two resistance elements in a hydrogen filled tube, one element being iron, which controls a current flowing to the primary of the transformer, and operated at about 500 deg. Cent. at which temperature iron has an exceedingly large resistance temperature coefficient. The other element is nichrome wire which is directly connected across the line; its temperature is adjusted by means of an external resistance to bring the controlling iron resistance element to a proper temperature. When adjusted, large variations in the line potential are compensated and the relay adjustment is stable.

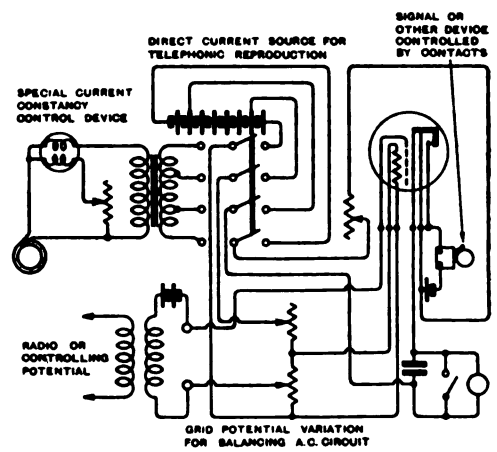
SIGNAL OR OTHER DEVICE CONTROLLED BY CONTACTS
DIRECT CURRENT SOURCE FOR TELEPHONIC REPRODUCTION
SPECIAL CURRENT CONSTANCY CONTROL DEVICE
RADIO OR CONTROLLING POTENTIAL
GRID POTENTIAL VARIATION FOR BALANCING A.C. CIRCUIT

Fig. 4. Telephone receivers and a call bell may be operated by connecting the relay in this manner.

Fig. 4 shows the same circuit with a change-over switch to allow the use of telephone receivers in the plate circuit, by which a call-signal relay and an audio-frequency relay in one valve are obtained.

This relay can be connected in a circuit as a reflex, a regeneration or an amplification valve, or in any connection in which the usual three-element valve is applicable, with the added advantage of the local circuit control of current of high density or high potential.

In conclusion, it may be stated that the Ruben relay has been designed to obtain a relay which could be controlled by minute energies in the form of currents of any frequency, either radio or otherwise; could be operated at adequate speeds for certain telegraph applications, and could control circuits of considerable current and potential. Its application is suggested for any conditions where these requirements are to be fulfilled, such as radio and carrier calling and recording systems, as a telegraph recorder and repeater, either line or cable, and for similar purposes.

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WOOD AS AN INSULATOR.

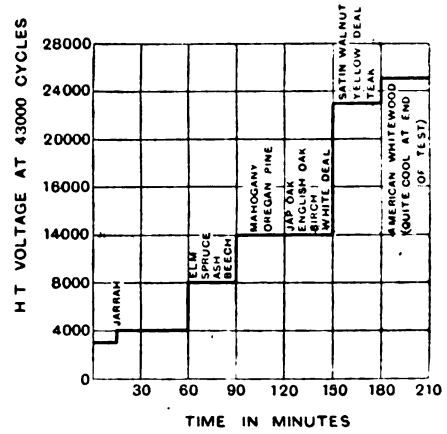
A number of tests have been made to find an insulating material suitable for supporting the turns of wire of the tuning coils employed in high power transmitters. The tests indicate that American white wood is superior to other woods.*

A MATTER of considerable importance in the design of inductance coils for high power stations is the selection of the material for supporting the cable. An exhaustive test of various materials under high frequency stresses has found that most of the insulating materials available tend to become hot, and in many cases end in smoke under the prolonged application of high frequency voltage. For instance, vitrified porcelain has been employed in the construction of these coils, but cracks, and molten porcelain has oozed out of the insulators.

On the ground of economy, and also of ease of make-up, wood offers distinct advantages over other insulators for the manufacture of large inductance coils for use at radio frequency.

In order to obtain information as to the properties of various kinds of woods, samples of a number of different varieties of wood were obtained and subjected to a number of tests. The samples were all cut to a standard size, namely, 1 in. by 1 in. by 4 ins. long, and were arranged in a symmetrical manner between two copper plates connected across the tuning inductance of an arc oscillating circuit tuned to approximately 6,800 metres. The voltage was applied and increased gradually until particular samples began to smoke and burn. These samples were then removed, and the voltage was further increased. The figure shows the steps in which the voltage was raised, and the length of time during which each particular voltage was applied to the samples. The point in the tests upon which each sample was removed upon showing signs of failure is indicated at the point at which the name of the wood appears.

It will be seen that the samples of American white wood were superior to those of any other wood tested. Subsequent tests carried out on large numbers of samples of this wood at a voltage of approximately 35,000 amply confirm the results of these tests, and in no case has any charring or undue heating been observed. In the case of one sample special arrangements were made to increase the voltage, and a flash-over occurred between the metal plates at 55,000 volts, the wood samples remaining undamaged.



The result of tests on specimens of wood.

Inductance coils have been made up using this kind of wood, and have given every satisfaction under working conditions. Such a coil at Northolt radio station has proved itself capable of carrying a current of 115 amperes, the voltage at the aerial [end approximating to 60,000.

*Abstract of address delivered by Mr. E. H. Shaughnessy before the Wireless Section of the Institution of Electrical Engineers on November 5th, 1924.

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A REINARTZ RECEIVER.

A DESCRIPTION OF A RECEIVER WHICH IS VERY EFFECTIVE FOR THE RECEPTION OF SHORT WAVELENGTH SIGNALS.

By E. J. MARTIN.

AFTER testing the various methods of tuning on short wavelengths, more especially below 100 metres, the author came to the conclusion that the Reinartz type of tuner was best for the following reasons:—(*a*) On these short wavelengths it is just as sensitive as any other tuner. (*b*) Reaction control is remarkably smooth, and has very little effect on tuning. (*c*) Hand capacity effects can readily be eliminated.

vernier are usually satisfactory. The inductances should be wound with a minimum of supporting material, and a fairly thick wire, such as enamelled No. 18, be used, with the turns spaced to reduce the self-capacity of the coil.

The following is a description of such a set tuning from about 60 to 180 metres, the circuit being as shown in Fig. 1.

Coil L_1 has 25 turns of No. 18 enamelled wire wound on six ebonite rods, set in a

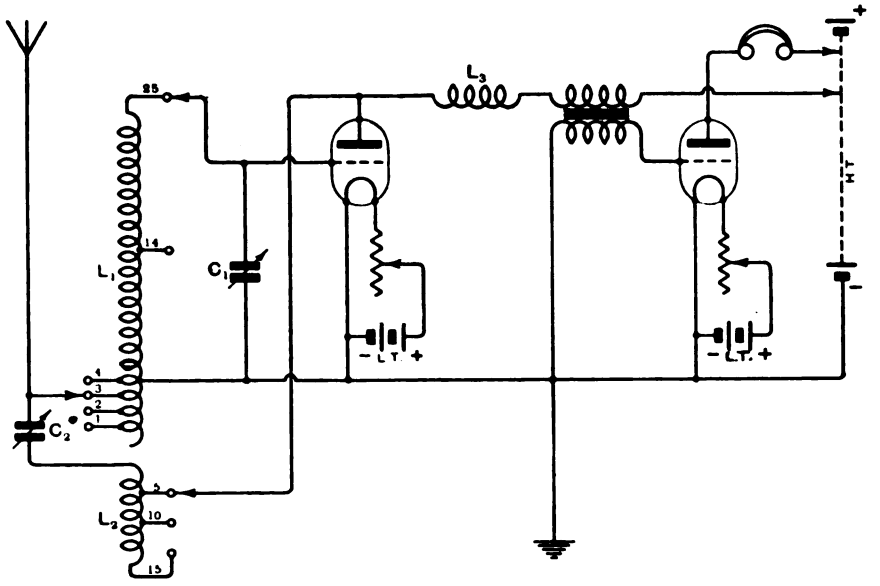

Fig. 1. Connections of a Reinartz receiver with one stage of low frequency amplification. The construction of the coils marked L_1 and L_2 is indicated in Fig. 2.

For tuning below 100 metres special care should be taken in the design of the inductances and condensers. The tuning condensers should be of the best construction, having low losses and a small minimum capacity. Square law condensers with a

circle 5¼ ins. in diameter, as indicated in Fig. 2. The rods are supported by wooden rings made of three-ply wood. Three supporting rings are employed. This is advisable, as otherwise the ebonite rods tend to warp and loosen the windings. The

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turns are spaced 1/10th of an inch, the wire being wound in slots cut in the rods with a hacksaw.

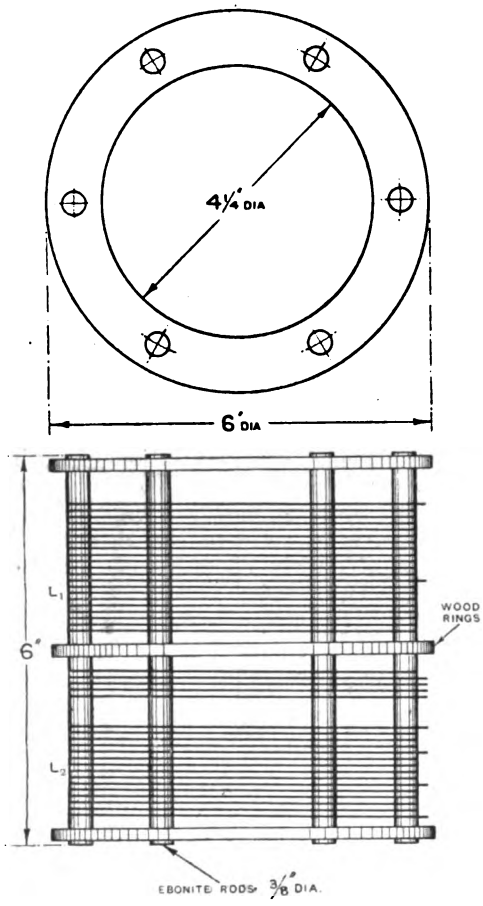


Fig. 2. The arrangement of the former and windings for coils L_1 and L_2.

Before winding, a suitable length of the wire should be unwound from the bobbin and stretched to remove the kinks. Tappings are taken at the first, second, third, fourth and fourteenth turns by scraping off the enamel insulation for a short distance and soldering on short lengths of tinned wire. Connection is made to these taps by spring clips.

Coil L_2 has 15 turns of No. 18 enamelled wire wound in a similar manner to coil L_1, a space of ¾ in. being left between the two windings. Both windings are wound in the same direction on the same former. Tappings are taken at the 5th and 10th turns.

A high frequency choke coil, L_3, having 200 turns of No. 36 D.C.C. wire wound on a cardboard former 2½ ins. in diameter, is employed between the anode of the first valve and the primary winding of the inter-valve transformer.

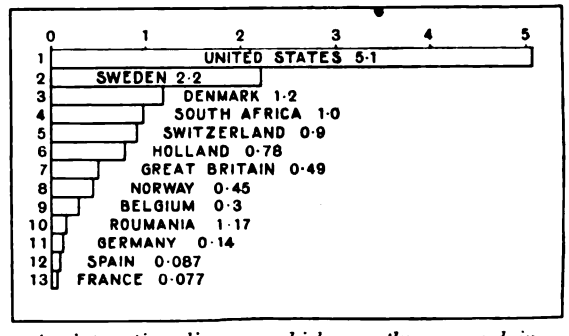
Condenser C_1 tunes the secondary circuit, and is of the square law type, having a maximum capacity of 0·0003 microfarads. The moving plates are connected to earth. Tinfoil is pasted on the back of the dial, and this is connected to the moving plates, thereby eliminating hand capacity effects.

The reaction condenser C_2 is an ordinary tuning condenser of 0·0003 microfarads maximum capacity.

The components should be well spaced, and the inductances especially should be well clear of surrounding objects. As in many receivers, the sensitivity of the set depends a great deal upon the efficiency of the valve as a detector. This depends upon the anode voltage, and upon the point where the earth tap is connected to the filament battery, that is to say, on the grid potential. In the set constructed by the writer a Wecovalve was used as a detector, which worked best when connected as indicated in the diagram. Ordinary hard valves require a grid condenser and leak.

Trouble may be experienced in making the receiver oscillate when it is working on or near the fundamental wavelength of the aerial. This difficulty may be overcome by connecting a suitable loading coil in the aerial circuit, thereby raising the fundamental to a value above the highest wavelength of the set.

A number of American amateurs are now working on short wavelengths, and they are received very loudly on this receiver.



An interesting diagram, which recently appeared in "Radio-électricité" showing the number of broadcasting stations in proportion to millions of population in the principal countries of the world.

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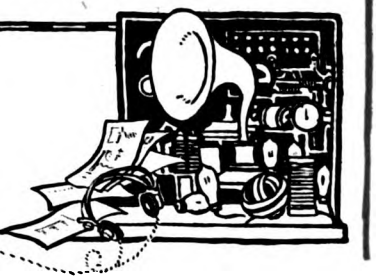
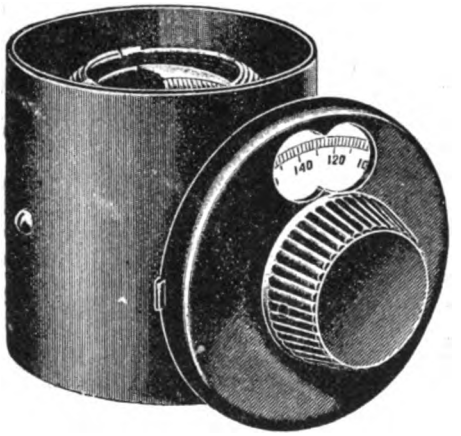
NEW APPLIANCES.



The Igranic Variometer.

An entirely new principle of variometer design has been introduced inasmuch as the windings are made self-supporting without the aid of solid moulding and to all intents and purposes the coils may be said to be



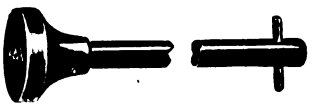
The new type Igranic variometer.

air supported. This form of construction is extremely efficient, and will no doubt be welcomed by those who are looking for something better in variometer design. The self-capacity of the winding is low, whilst a high value of mutual inductance is obtained between the two coils. A Paxolin tube surrounds the windings to give them mechanical protection, whilst the variometer is attached to the panel by one-hole fixing.

The instrument is supplied in two types, one covering a band 280 to 650 metres, and the other 700 to 2,400 metres, when connected to an aerial of the usual dimensions.

Anti-Capacity Extension Handle.

Designed ordinarily for use with the variable grid leak manufactured by Messrs. A. H. Hunt, Ltd., this extension handle can easily be adapted for use with almost any component instrument. It is only necessary to drill a hole in the centre of the knob and

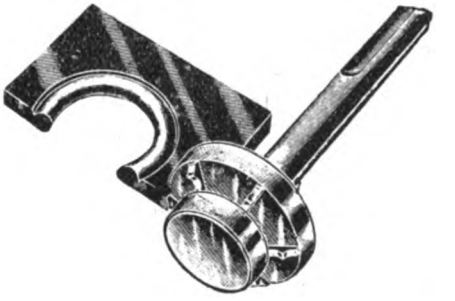


A useful extension handle.

make a saw-cut to carry the pin. A good positive drive is obtained and the hand is removed at a distance of several inches from the instrument panel.

The "Bezel" Beading Tool.

This useful tool enables the amateur to get a full true bead round a large-sized hole such as an inspection or valve window. Its end is fitted with a guide piece which keeps the tool centre in the hole. Six



The "Bezel" beading tool, a recent product of the Rockwood Co., Ltd.

steel cutters are suitably arranged to produce the bead and having surfaces so set that chattering is avoided and a good smooth cut obtained. The tool is obtainable in two sizes, suitable for use on holes of $\frac{3}{4}$ in. and 1 in. diameter. Extra sets of cutter blades are supplied.

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VALVE TESTS.

MULLARD D 3 VALVES.

IN addition to the two valves of the D.06 type, recently reviewed in these pages, we at the same time received from the Mullard Radio Valve Co., Ltd., samples of another of their new productions known as the D.3.

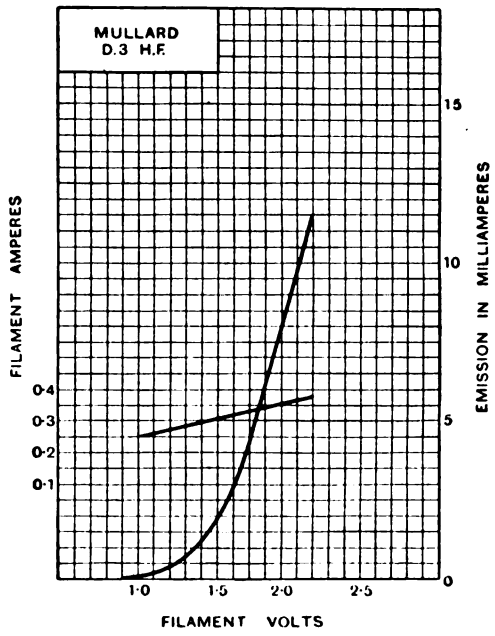

Fig. 1. Curves showing the filament current and emission for various filament voltages.

These valves are designed to work off one accumulator (1·8 to 2 volts), and consume about 0·35 ampere. As in the case of the D.06, two types are made, one having a moderately high impedance and suitable for H.F. amplification and detection, the other being designed for L.F. work and having a lower impedance.

The old cylindrical method of construction has been maintained in the D.3, but the electrodes are mounted on the slant, as was first done in the D.F. Ora, and more recently in the D.06.

Like all the newer Mullard valves, their appearance is very pleasing, the new ridged base adding to the effect, and we are glad to notice that the sealing device, already described in connection with the D.06, has been applied to this type, and, no doubt, will be extended to all this company's valves in due course.

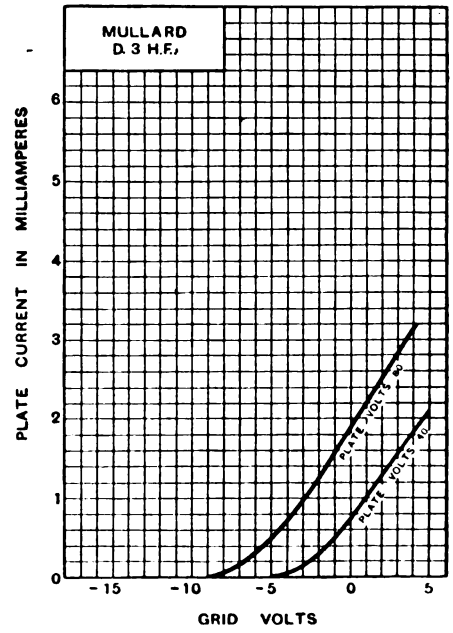

Fig. 2. Plate current-grid volts characteristic curves.

The results obtained from our usual bench tests are shown in Figs. 1 to 6. Figs. 1 to 3 refer to the H.F., and Figs. 4 to 6 to the L.F. valve. Figs. 1 and 4 show the filament characteristics of the two tested samples.

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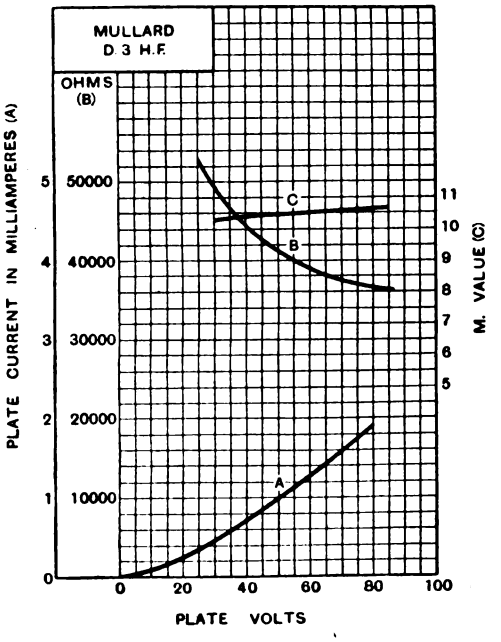

Fig. 3. Curves showing the variation of plate current (A), *impedance* (B), *and amplification factor* (C) *with plate volts.*

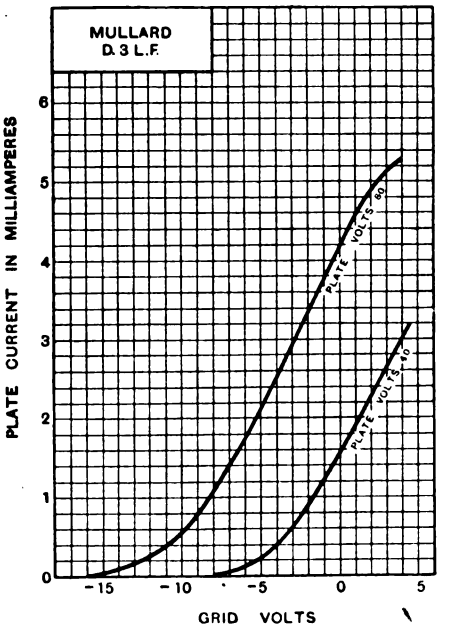

Fig. 5. Plate current-grid volts characteristic curves.

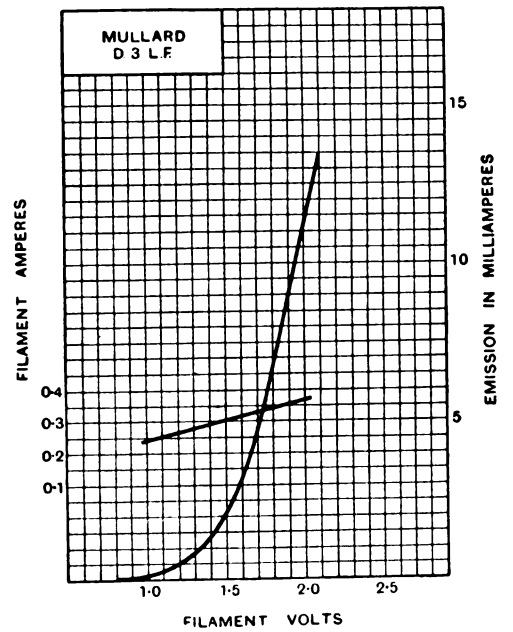

Fig. 4. The filament current and emission for various filament voltages.

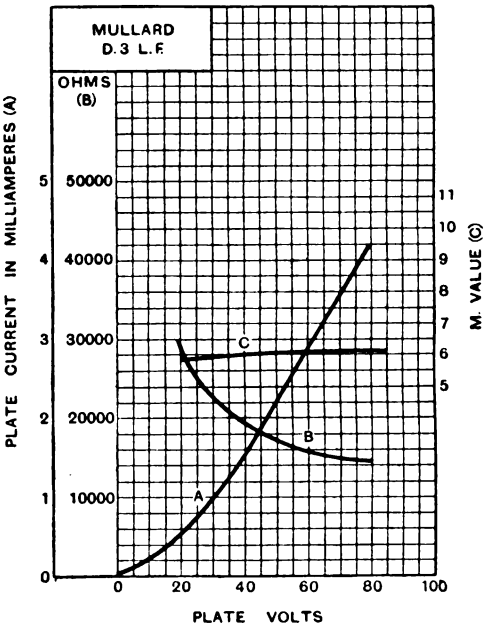

Fig. 6. Curves showing the dependance of the emission (A), *impedance* (B), *and amplification factor* (C) *on the plate volts.*

C

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The emission, when the filament is connected straight across the 2-volt accumulator, is quite liberal, and the H.F. valve can usually be dimmed quite appreciably, for at 1·8 volts an emission of 6 milliamperes is obtained, which is ample for the purpose.

It is interesting to compare the two sets of plate-current grid-volt curves, Figs. 2 and 5, for as the plate voltages are 40 and 80 in both cases, the result of modifying the grid construction is very clearly shown. At a moderately low plate potential (80 volts) the L.F. valve shows a particularly good operating region, and should give excellent service. For maximum input a bias of, say, −4 volts should be applied to the grid. The L.F. valve has a magnification factor of about 6, with a plate impedance of approximately 20,000 ohms. The value of these factors for the H.F. type are substantially higher, being of the order of 10 and 35,000 ohms respectively. Once more the effect of modifying the grid can be appreciated by observing the differences in similar curves of Figs. 3 and 6.

These valves were submitted to a particularly long circuit test. For the D.3 H.F., operating either as a H.F. amplifier or detector, a plate potential of 40 volts was used with excellent results. The setting was by no means critical, however, and any H.T. voltage from 40 to 60 may be used.

For the L.F. valve, we used 80 volts on the plate, and a grid bias of negative 4. Good clear reception was obtained, quite free from distortion.

The D.3 type of valve may be recommended.

AN INTERESTING RECEIVER.

THE W.P. "EZI" WIRING SERIES No. 4.—THE FOUR VALVE COMBINATION RECEIVER.

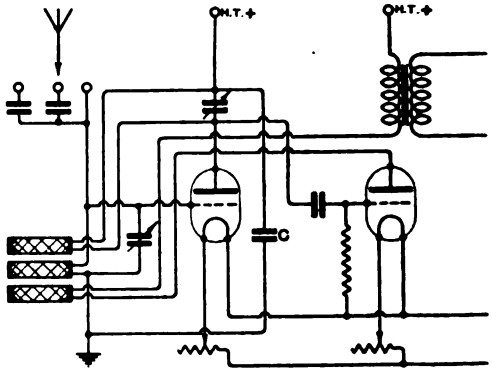
By W. JAMES.

This receiver was designed to give the maximum degree of amplification with selectivity and purity. A total of four valves are employed, the first giving high frequency amplification, the second detection, and the third and fourth power amplification. The first and last valves may be switched out when desired.

Among the special features of the receiver is the method of connecting the first valve. To bring it into use and so obtain H.F. amplification, it is only necessary to turn on the filament resistance. When H.F. amplification is not required, the filament resistance is simply turned off. The anode circuit then automatically becomes a secondary circuit between the aerial and the detector.

For the benefit of readers who would like to try this arrangement, a circuit of the H.F. portion is given in the accompanying figure, from which it will be seen that the aerial coil is mounted in the central holder, and the reaction and anode coils in the outer holders of a three-coil tuning stand.

The booklet contains four beautiful photographs of the receiver printed on art paper, four full-size drawings (20 ins. by 8 ins.), and a theoretical circuit and practical wiring diagrams printed in four colours, with full instructions regarding the components, their assembly, and the operation of the receiver.



The condenser C should have a fairly large capacity, such as 0·005μF.

Published by the Wireless Press, Ltd., price 2s. net, or 2s. 2d. post free, and obtainable from all booksellers.

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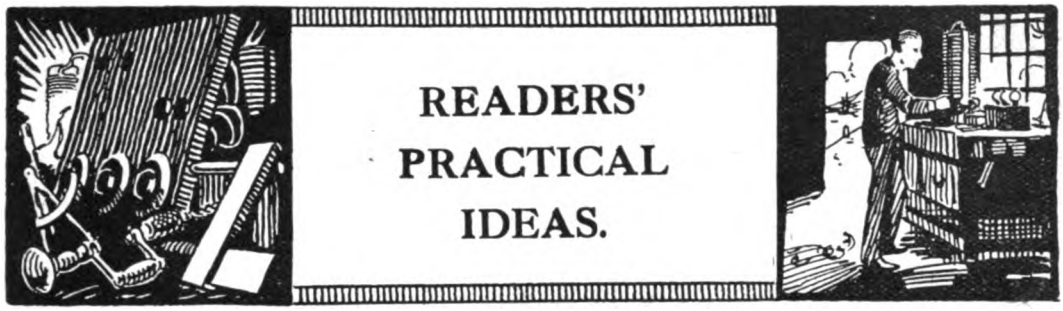
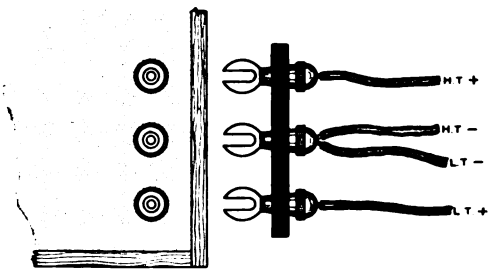


This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Foolproof Connections.

WHEN a number of connections such as positive and negative H.T. and positive and negative L.T. have to be made to a receiver each time it is used, trouble can be saved and the risk of wrong connections eliminated by using a terminal strip. Holes should be drilled in a strip of ebonite corresponding with the positions of the terminals of the receiver and spade terminals passed through the holes with the nuts screwed up from the reverse side. The appropriate



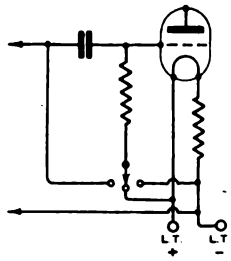
Spade connectors carried on a strip of ebonite simplify the connecting up of the battery leads.

wires are permanently connected to the spade connectors and thus by a single operation the battery connections may be removed from the set. By unevenly spacing the terminals the chance of completely reversing the strip is avoided.

A. R. G.

Regulating Grid Potential.

THERE are three usual methods of connecting up the grid leak in a detector valve circuit. It may be connected across the grid condenser, while the lower end of the inductance may be connected either to the positive or negative of the L.T. battery, depending upon the potential required. Under certain conditions a positive potential may be required, whilst



The use of a three-way switch for regulating grid potential.

in others the grid may need to be negative, the best adjustment depending upon the type of valve used and whether it is desirable to stimulate self-oscillation. By introducing a three-way switch the grid leak can be connected across the grid condenser or may be applied to either the positive or the negative of the battery.

K.S.W.

Setting Indicator for Rotating Dials.

TO make a setting point for the rotating dials of variable condensers, variometers, etc., drill a hole through the panel at the required spot and plug it with a peg made from a white Eronoid knitting needle, which should be driven in fairly tightly with a little seccotine or other adhesive. The projecting pieces can be trimmed off flush with a sharp chisel or file and rubbed down with the remainder of the panel. The edge of the rotating dial should slightly overlap the white spot; it is then quite unnecessary to use a centre line across it as the

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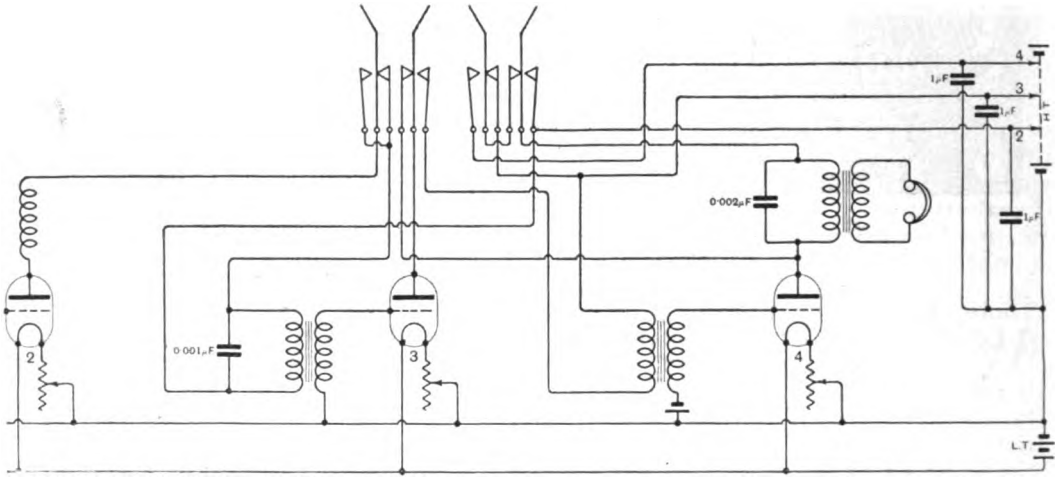
division marks on the edge of the dial can be observed quite accurately with regard to the position of the dot.

J. H. S. F.

the varnish will distribute itself uniformly throughout the winding and only a minimum quantity will be retained.

C. A. J. B.



Dewar key switching of low frequency amplifying stages, in which provision is made to pick up suitable H.T. battery potentials.

An Improved Switching Circuit.

WHEN introducing a switch for changing the number of low frequency amplifying stages in circuit, care must be taken to see that changes are not made in the potentials applied to the plates of the valves. In the accompanying circuit this has been provided for, and it will be observed that the valves are correctly operated as regards H.T. potential, irrespective of the number of amplifying stages in operation.

V. E. S.

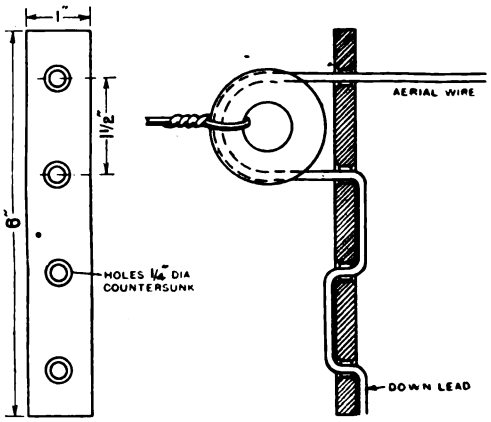
Removing Excess of Varnish.

PILE wound coils are sometimes immersed in varnish in order to thoroughly impregnate them so that when dry they are quite hard and the turns held firmly together. Excess of varnish, however, is undesirable, and if the coils are hung up to drain it will be found that the surplus liquid does not run through but evaporates rapidly and collects on one side of the coil. A simple method of overcoming this is to mount the coil on a wooden former which has a centre hole, so that a metal screw can be passed through, and nuts clamped up on either side. Then by holding the stem of the screw in the chuck of a small hand brace the coil can be rotated at a high speed. When revolving, the varnish will distribute itself uniformly throughout the winding and only a minimum quantity will be retained.

C. A. J. B.

Aerial Wire Terminations.

BY passing the aerial wire through holes in an ebonite strip a termination can be made on the insulator which will provide for adjusting the length and tension on the aerial as may be required.



Adjustable clamp for securing the aerial wire to the insulator.

E. R. P.

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THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

The Super-Heterodyne Receiver for Telephony.

THE beginner sometimes experiences difficulty in understanding why an oscillator and two detectors are required in a super-heterodyne receiver employed for the reception of telephony. At first it seems that only one detector—as in ordinary receivers—is required. A super-heterodyne receiver, however, is an instrument which changes the wavelength of the incoming telephony and then amplifies it at the different wavelength. To change the wavelength an oscillator and a detector are employed, and it is customary to refer to this portion of the receiver as the "wave changer." When one valve is used in the oscillator and another in the detector, the arrangement is referred to as a two-valve "wave changer." Some super-heterodyne sets of the latest design have a single-valve wave changer, the one valve giving rectification and generating oscillations. Such sets are manufactured by the Radio Corporation of America and one was described recently in this journal.

The operation of the receiver may be explained with Figs. 1 and 2. In Fig. 1 we have diagrammatically the arrangement of a super-heterodyne receiver arranged for telephony and in Fig. 2 a series of curves, showing the currents flowing in the various parts of the receiver. First we have the currents flowing in the aerial and tuner due to the latter being tuned to a telephone transmitter sending

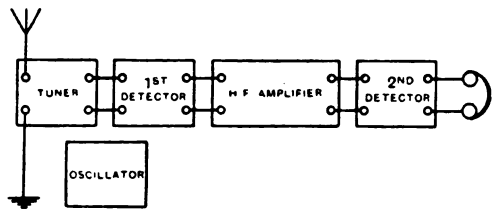

Fig. 1. The arrangement of a super-heterodyne receiver for telephony reception.

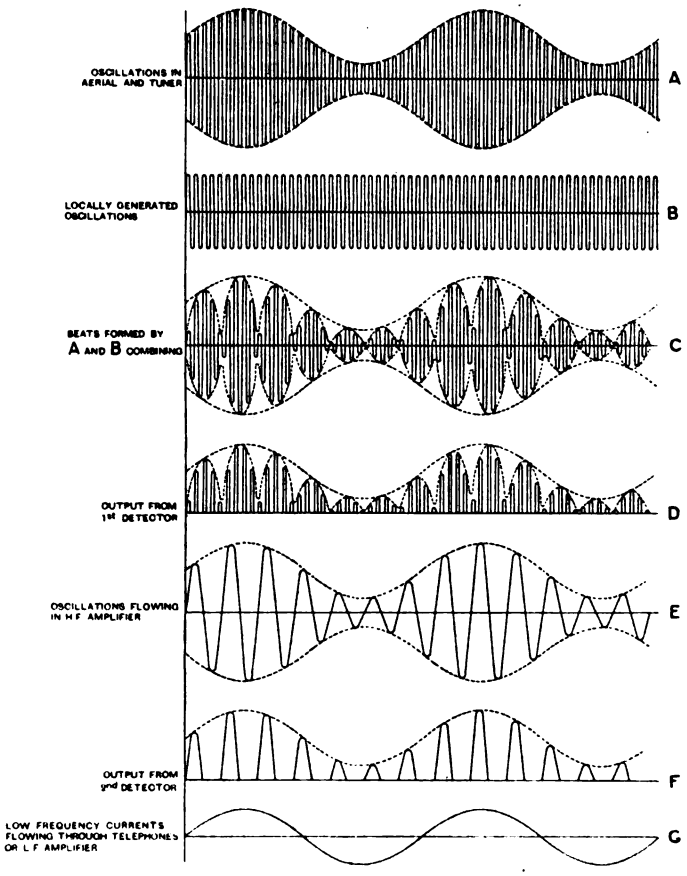

Fig. 2. A series of curves showing the operation of a super-heterodyne receiver. Unfortunately it is not possible in a diagram of this size to give a scale drawing.

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out a single note. These are represented by curve A. Their wavelength may, for instance, be 300 metres, corresponding with a frequency of 1,000,000 cycles per second and a modulating frequency of say 1,000 cycles. If the oscillations were tuned in on an ordinary receiver a note of 1,000 cycles would be heard in the telephones. Coupled to the tuner is an oscillator that may be adjusted to produce oscillations having a frequency above or below that of the incoming signal. The oscillations set up in the tuner by the oscillator are represented by curve B, and may, in a practical case, have a frequency of 1,060,000 cycles.

Thus in the tuner, which is connected to the first detector, we have oscillating currents of two frequencies and they combine to form a beat frequency as indicated in curve C. Notice that the outline or envelope of the signal is unchanged, but that the amplitude of the oscillations is varying at a high frequency.

The frequency of the beats is the difference in the frequency of the incoming signal and of the local oscillations—in this instance 60,000 cycles. A current having a frequency of 60,000 cycles cannot, of course, be heard in telephone receivers, and in fact corresponds with oscillations having a wavelength of 5,000 metres.

Curve D represents the rectified currents flowing in the anode circuit of the detector. Now the anode of the detector is connected to a circuit tuned to 5,000 metres; the oscillating currents having a wavelength of 300 metres therefore pass through this circuit and return to the filament side of the detector, while the oscillations having a wavelength of 5,000 metres are passed to the high-frequency amplifier. The currents flowing in the amplifier are therefore modulated currents having a wavelength of 5,000 metres, as indicated in curve E. These are rectified by the second detector, producing currents as in curve F in the anode circuit of the detector. The high-frequency component of the signal passes to the filament through the condenser, which is usually provided in the circuit, leaving the signal as in curve I to operate the head telephones or be amplified in the low frequency amplifier.

A study of the curves should enable the reader to understand exactly the principles of the super-heterodyne receiver, and will certainly enable him to obtain better results from a receiver of this type which he may make up from a published description.

The Use of a H.F. Amplifying Valve Before the First Detector.

It is usual to employ a frame aerial with a super-heterodyne receiver and to couple the source of local oscillations to the grid circuit of the first detector, as illustrated in Fig. 1. The locally generated oscillations therefore flow in the frame aerial and cause oscillations to be radiated. However, the local oscillations are usually so we k that very little or no interference is experienced as a result of the locally generated oscillations flowing in the frame aerial. But if an outdoor aerial and earth are employed, as indicated in Fig. 3, a relatively considerable amount of energy may be radiated and cause interference to other listeners. This is quite

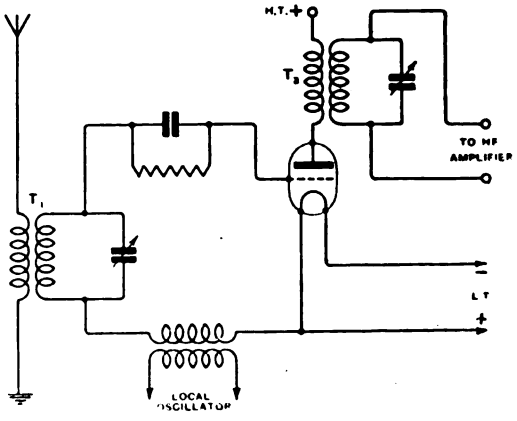

Fig. 3. Interference can be caused by employing an outdoor aerial in this manner.

undesirable, but yet there may be occasions when it is required to employ the outdoor aerial in place of the relatively inefficient frame aerial.

The radiation of energy due to the local generator of oscillations may, for practical purposes, be eliminated by employing a valve between the aerial and the first detector, as indicated in Fig. 4. Here we have the aerial coupled by a transformer T_1 to the grid of the first valve and an intervalve transformer T_2 between the anode of the first valve and the detector. The local oscillator is coupled to the grid circuit of the detector; hence only weak oscillations which pass through the capacity of the first valve

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reach the aerial. If the first valve and transformer are arranged on the neutrodyne principle, the amount of energy flowing from the first oscillator to the aerial is negligible.

In the figure we show an untuned transformer. If a tuned transformer is employed another adjustment is added to the set which is undesirable. The special merit of the super-heterodyne receiver is, of course, the selectivity and sensitivity which is secured with only two tuning adjustments. Tuning is rendered difficult if a third critical adjustment is added.

It should be remembered, however, that the selectivity of the set depends a good deal on the tuner—whether the latter comprises a frame aerial tuned with a condenser, or tuning coils and a condenser connected to an aerial as in Fig. 3. Therefore a good tuning condenser and good coils must be employed if reasonable selectivity is to be secured. However, even though the best components are employed, it is sometimes desirable to improve the selectivity. This can be done by using one stage of tuned high frequency amplification before the first detector, as indicated in Fig. 4. The selectivity of the set is then considerably better than without the stage of high frequency amplification.

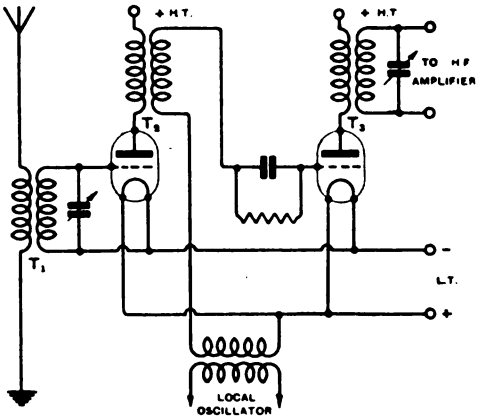

Fig. 4. Showing the connections of a high-frequency stage of amplification to prevent radiation, give sharper tuning and increase signal strength.

CORRESPONDENCE.

The Post Office and Receiving Licences.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Attention having been called to the concluding paragraph of your article entitled "The Post Office and Receiving Licences" in the current number of *The Wireless World and Radio Review*, I am directed by the Postmaster-General to state that you are right in assuming that no alteration is being made in the arrangement under which an experimenter who uses several wireless receiving sets in the same room or building in the course of his experimental work is not required to take out more than one wireless licence in respect of them.

F. J. BROWN.

General Post Office,
London, E.C.1.
January 2nd, 1925.

Chelmsford Reception in Poland.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I would like, through your excellent paper, to express my gratitude to the Chelmsford station (5 XX) which in spite of the distance of 1,600 kms. we can hear nearly every day, better than any other European station. This fact, combined with the excellence of the programmes, is most gratifying.

If I am not mistaken, the Chelmsford station has recently been working on rather lower than 1,600 metres. We are generally able to listen to Paris (1,500 kms.), Rome (1,400 kms.), Moscow (1,000 kms.), and German stations (700-800 kms.).

Our set is a six-valve French make and is installed in our local Club in Brzesc on Bug (Poland).

JADEUSZ FEDOROWICZ.
(*Chairman of the Radio Section*).

Calls Heard in Mosul.

The following letter is of special interest, the receptions referred to having been carried out by an operator in Mosul with whom several British amateurs have worked.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I attach a list of calls heard for insertion for interest to those concerned.

British—2 NC, 2 XA, 2 OD, 2 KF, 2 NM, 2 WJ, 6 NF, 5 NN, 5 RZ, 5 BV, 5 MO, 2 WJ, 2 SZ, 2 NO, 2 SH.

U.S.A. 1 ABS, 2 YT, 4 XE.

French—8 B, 8 QG, 8 SM, 8 S, 8 SSC, 8 YG, 8 DU, 8 AQ, 8 RO, 8 FC, 8 GM, 8 TG, 8 AP, 8 FQ, 8 UU.

Dutch—PC 1, 0 CTU, NSF.

Finnish—FN 1 B, FN 2.

Danish—7 EC.

(o-v-o).

R. F. DURPANT.

Mosul, Iraq.

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PATENTS AND ABSTRACTS

Variable Condensers.

An interesting variable condenser is sketched in Fig. 1. A containing shell is formed of two thin dished celluloid sheets, A_1 and A_2, joined at their edges, B. A wire, C, bent in the form of a semi-circle, lies inside the shell, and one end, D, is employed as a connection. The shell contains a conducting

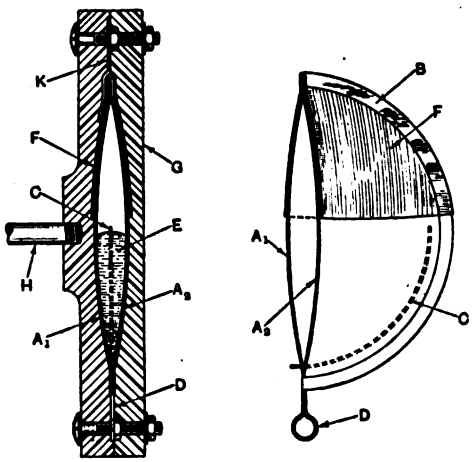

Fig. 1. *A novel variable condenser.*

liquid—for instance, mercury—filling preferably a little less than half the chamber of the shell. On the outer face of the wall of the shell is a conducting coating F, which may be of metal foil. In order to produce the largest possible capacity for a given size, it is preferable that the metal coating be as closely in contact as possible with the surface of the walls A_1 and A_2; for example, by chemically or electrolytically precipitating the metal thereon. Also these surfaces may be sprayed with powdered metal, or coated with metal-containing paint. The complete shell thus formed may be enclosed in an insulating housing G, having a spindle H by means of which the casing may be rotatably mounted. The condenser is mounted so that the central plane of the shell is vertical.

The capacity of the condenser is practically zero when the portion of the shell carrying the metal coating is in the upper position. The capacity of the condenser is greatest when the case G is turned so that the conducting liquid E is covered by the whole of the metal coating. This variable condenser is described in Patent No. 223,831.

A Variable Grid Leak.

The variable grid leak sketched in Fig. 2 is of the type in which the resistance is varied by adjusting the length of high resistance material between the terminals of the leak (Patent 224,295). Referring to the figure, 1 is a tube of ebonite bored as indicated, with a metal plug and terminal 2 at one end, and a threaded bush 3 at the other. A short length of screwed brass 4 passes through the

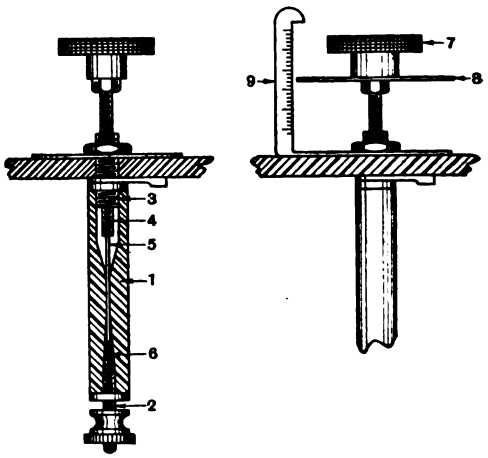

Fig. 2. *A grid leak.*

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bush and carries at one end the knob 7, and at the other end a contact pin 5. In the tapering portion 6 of the container is a high resistance material such as powdered graphite, a paste of slate powder in oil or Indian ink. The resistance between the terminals of the leak is adjusted by turning the knob. When the contact pin is screwed down to touch the end of the plug 2, the resistance is zero, and as the pin is withdrawn from this position the resistance increases, until, when the pin is removed completely from the high resistance material, the resistance is very great.

The resistance may be calibrated with the aid of the dial 8 and the scale 9.

Duplex Wireless Telephony.

In duplex telephone systems using the same frequency for telephoning in both directions, it has hitherto been thought necessary accurately to tune each transmitting station to the frequency to be employed. It is well known, however, that it is extremely difficult to get two stations tuned to the same frequency. According to this invention (Patent No. 207,827), these difficulties are overcome by so arranging one of the stations that it is caused to radiate oscillations of the desired frequency by the oscillations received from the other station. This is effected by employing a valve, and by influencing the grid of that valve by the incoming oscillations.

Fig. 3 shows two intercommunicating stations A and B. Station A is provided with a valve generator, having connected to its anode and grid a circuit 1 tuned to the frequency to be employed. Speech currents may be applied to the grid in the well-known way through a transformer 2. Station B has a valve, the grid circuit of which contains a coil 3 coupled to the aerial, so that the oscillations from station A influence the grid of the valve at B; consequently the valve at B, by means of coils 4, 5, impresses upon its aerial oscillations of this frequency. Speech currents are applied to the grid through a transformer 6, and telephones are connected in the anode circuits of the valves.

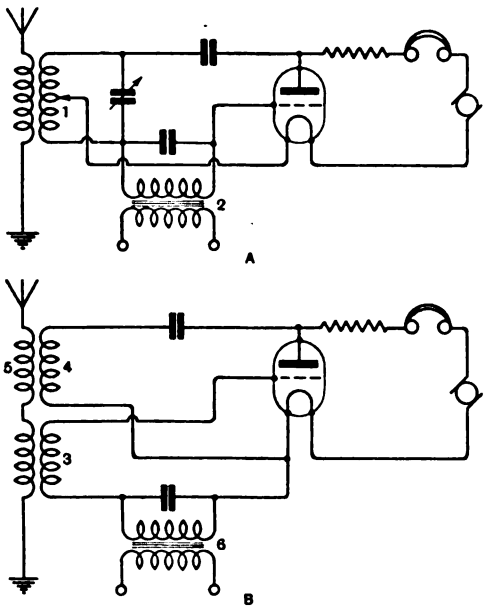
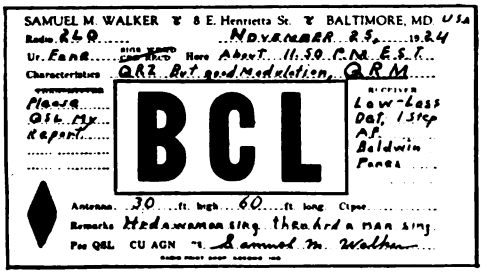


Fig. 3. Duplex wireless telephony.

The speech which sets up the currents in the primary of transformer 2 at station A will be reproduced in the telephones of station B, and, similarly, speech at station B will be heard in the telephones of station A.

In some instances, of course, it may be desirable to interpose an amplifier between the aerial and coil 3.


SAMUEL M. WALKER 8 E. Henrietta St. BALTIMORE, MD USA
Radio 2 4 9 ... NOVEMBER 25 ... 1924
Ur. Fone ... Here About 11.30 P.M. E.S.T.
Characteristics QRZ But good modulation, QRM
Please ... QSL My ... Report ...
BCL
Receiver Low-Loss Det. 1 Step A.F. Baldwin Phones
Antenna 30 ft. high 60 ft. long Copper
Remarks Hexagonal sing thread and man sing
Pse QSL CU AGN Samuel M. Walker

NOT A TRANSMITTER.

From a first glance at the accompanying QSL card the impression is gained that Mr. Samuel M. Walker is a transmitter. The familiar "call letters" stand, however, for "broadcast listener" The use of such a card by holders of receiving licences has, we understand, been authorised by the American Amateur Relay League.

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NOTES & NEWS

A course of lessons in English is to be given from the Vienna broadcasting station by Professor MacCaul Smith, President of the Vienna Progress English Club.

* * * *

Telegraphic and wireless communication has been established between France and Soviet Russia, states our Paris correspondent.

* * * *

Two-way communication was carried out between G 2 OD (Mr. E. J. Simmonds) and Mexican 1 B at 8 a.m. on January 1st.

* * * *

About 2,700 licences have been issued for wireless receivers in the Irish Free State.

* * * *

During the recent gales the head of the mast at the Cullercoats wireless station was blown down. Work was continued with a temporary aerial.

* * * *

Complaints are made that telephone lines used by the Bournemouth Fire Brigade are being employed to support wireless aerials. The Town Council has decided to take action against offenders.

* * * *

RECORD AMATEUR OVERLAND TRANSMISSION ?

Mr. J. A. Partridge (2 KF) of Merton Park, has received a communication from Mr. Richard Jamas, of Saigon, French Indo-China, confirming the reception of his signals on Saturday, December 6th, at a strength of R 1-2. Mr. Jamas, whose address is 21 rue Richard, Saigon, employed a three-valve (1—v—1) receiver.

This transmission of seven thousand miles, mostly overland, probably constitutes an amateur record.

STORM UPSETS DUNDEE PROGRAMME.

Dundee listeners on January 2nd experienced a new form of simultaneous broadcasting, states the *Dundee Courier*. Owing to the heavy storms which have been sweeping the country many telephone lines broke down and broadcasting stations were isolated. The engineers of the Dundee Relay Station got over the difficulty by tuning-in the Chelmsford station on a valve set and retransmitting the news bulletin and talks. The bad atmospherical conditions caused some disturbance, otherwise the transmission would have been perfect.

ARGENTINE DA 8.

An early Sunday morning vigil is being kept regularly by Mr. Carlos Braggio, DA 8 (ex CB 8) of Buenos Aires, in the hope of two-way communication with British amateurs. Mr. Braggio would be especially glad if amateurs would call him before sunrise in England. Although it is now summer in the Argentine and atmospherics are plentiful, it is hoped that short waves and a modicum of luck will "do the trick."

DA 8 operates on 80 metres, with a power of 200 watts.

AUSTRALIAN WORKS WITH MOSUL.

In a letter which we have received from Mr. A. Nixon, of Manchester, our correspondent states that on Tuesday, December 30th, he intercepted signals exchanged between A 3 BD and GHH 1 (Mosul, Iraq). The Australian was first readable at 7.25 p.m. and the two-way messages were readable until 7.45 p.m.

NORTHOLT CAUSING BROADCAST DISTURBANCE ?

General Post Office wireless experts are making a thorough inquiry into the allegations that the Government wireless station at Northolt is responsible for the numerous interruptions which have occurred of late in the reception of broadcasts from 2 LO and the other British home stations, says the *Morning Post*.

General Post Office experts have contended that Northolt is not the offending station, but both professionals and amateurs are stated to have convinced the Post Office that a further inquiry is justified.

It is understood that when the experts have completed their inquiry a report will be made to the general public, and remedial changes will be made, if necessary, in the wavelengths.

THE PARIS AMATEUR CONFERENCE.

In view of the International Conference of Radio Amateurs in Paris during Easter, Mr. Gerald Marcuse, British representative of the International Amateur Radio Union, would be glad to hear from British amateurs who wish to attend. Mr. Marcuse may then be able to arrange for a party to proceed to Paris under special travelling facilities, provided the numbers are sufficient. As accommodation in Paris is limited during the Easter week, the desirability of making early arrangements will be apparent. Enquiries should be addressed to Mr. Gerald Marcuse, *c/o* The Radio Society of Great Britain, 53 Victoria Street, London, S.W.1.

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PORTO RICO REACHES EUROPE.

A special programme was recently broadcast for the benefit of Spanish radio enthusiasts by the Radio Corporation of Porto Rico, a subsidiary of the International Telephone and Telegraph Co. from its station, WKAQ. The transmission was very clearly heard in Spain and many letters of congratulation have been received from all parts of Europe. The station is equipped with a Western Electric 500 watt transmitting set employing the Heisling modulation circuit with five valves.

AUTHOR'S BROADCAST RIGHTS.

In consequence of complaints regarding the broadcasting of copyright works in Spain, the Society of Authors is to hold an international congress in Madrid from May 16th to 18th, with a view to secure author's rights.

BELGIAN TRANSATLANTIC SUCCESS.

Successful two-way communication with Canadian and American amateurs is reported by Belgian P 2, who worked on December 10th with 3 BP, on a power of 50 watts. On December 21st his signals were stated to be of "wonderful strength" by 1 AR, with whom he worked on that date. On the same morning he carried on two-way communication with U 1BSD, U 1SF and U 1AAC.

MORNING RECEPTION OF U.S.A.

Interesting details on the "early" and "late" reception of U.S. amateur stations are forwarded by Mr. W. R. Burne, of Sale, Cheshire.

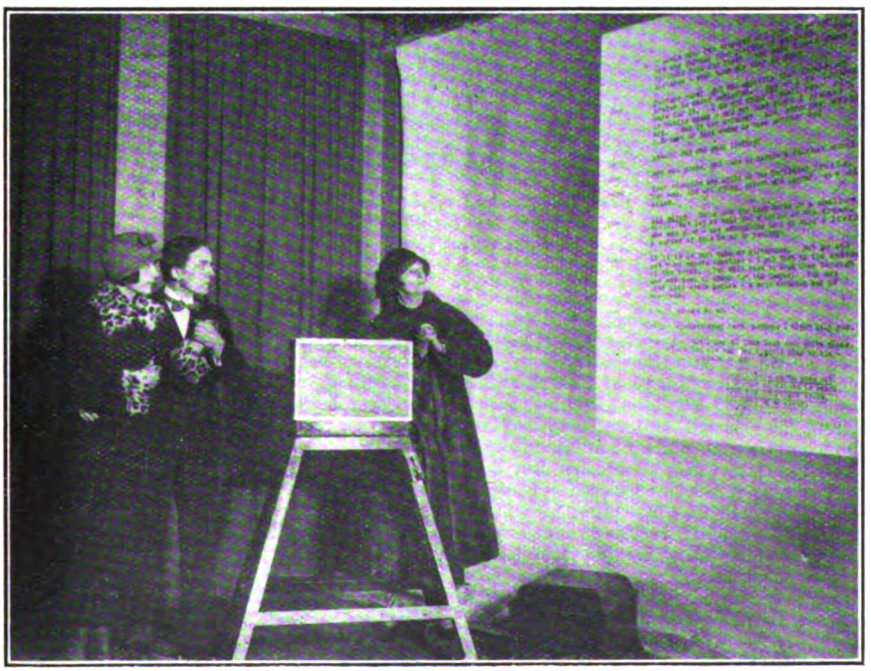
On Saturday, December 20th, he states, American stations were coming in strongly at 9.15 p.m., while on the following morning the last U.S. station was heard as late as 10.25 a.m.

It remains to be seen whether other British amateurs have picked up American signals at still more extraordinary times.

N.P.L. REPORT ON VARIABLE GRID LEAKS.

A number of exhaustive tests were recently carried out on six "Bretwood" variable grid leaks submitted to the National Physical Laboratory, by Messrs. Radio Improvements. The outcome of these tests is an interesting report, in which tabulated results are given together with graphs.

In every case the observations were made after one minute's electrification at a pressure of 100 volts. The current carrying capacity can of course be estimated for any given resistance value. To test the variation of resistance with time, three grid leaks were submitted to a trial extending over fifteen weeks, and the results obtained indicated comparatively small changes of resistance over this period. The influence of temperature on the resistance of three specimens was also measured between 20° and 27° C, and it was found that the average change in resistance was 6 per cent. for 1° C, the resistance decreasing with increased temperature. The graphs serve to show that the resistance of the grid leaks increases in practically a straight line with each turn of the knob. We understand that copies of this interesting report are obtainable from Messrs. Radio Improvements, Ltd., of 12 to 18 London Mews, Maple Street, London, W.1.



Simplifying the task of the broadcast actor. The method depicted above, in which the MS. of the play is projected on a screen, is now in use at 2 LO.

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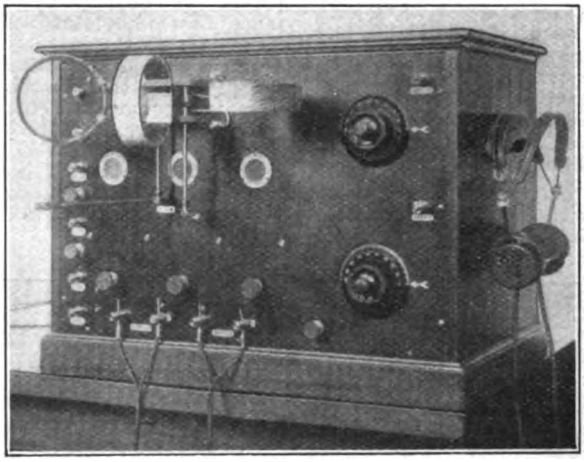
G 2NM RECEIVED IN INDIA.

Mr. Gerald Marcuse (2 NM) of Caterham, Surrey, has received a letter from India confirming that he is the first British amateur to be heard in that country. The writer is Mr. George Benzie, formerly an active amateur in Scotland, who now resides at Cachar, India. According to arrangement, Mr. Benzie listened for 2 NM's signals at 11.45 p.m (G.M.T.) on December 4th, and was rewarded by hearing strong and steady signals from the British station. Mr. Benzie is situated approximately 5,000 miles from London and 350 miles N.E. of Calcutta. His set is of the home-made variety, employing three valves, and his aerial, a four-wire cage, is 40 feet high and 80 feet long. Many U.S. and several Australian and New Zealand amateur stations have been heard, and the Europeans picked up include 8 BF, UFT 2, and SMZY.

CZECHO SLOVAKIAN AMATEUR ?

On the night of December 30th, states Mr. L. H. Thomas (6 QB), of West Norwood, he picked up a C.W. call at 10.45 G.M.T. on 84 metres, which ran as follows : " 5 MO 5 MO gcs OK 1 OK 1." It is possible that the prefix " CS " stands for Czecho - Slovakia, and Mr. Thomas would be glad to know if any other reader has heard this or any other Czecho - Slovakian station. OK 1 was pure C.W. and his signals were received at R5-6 on a two-valve set (0—v—1).



A neatly-designed receiver of home construction, built by Mr. A. M. Nimrod, of Edinburgh. The set comprises three valves (1—v—1).

MORE EUROPEAN RECEPTION IN IRAQ.

Following on the reports of two-way working between British amateur stations and an amateur at Mosul, we have received interesting details of the reception of European short wave signals at Basrah, Iraq. The information reaches us from Mr. J. E. Long, Officer-in-Charge of Basrah Radio.

On December 2nd, 2 YT, the Poldhu experimental station, was heard transmitting to Cape Town at R9 strength with a clear and steady note. On the following day, GHH 1 (Mosul) and 8 BO were both received, the former clear and steady at R4, and the latter with a " warbling A.C. note " at a strength of R6. The receiver consisted of a two-valve loose-coupled straight circuit with reaction on the secondary. In the reception of 8 BO, the aerial consisted of a 12-ft. length of single-strand wire fastened to nails in a brick wall !

SWANSEA READERS NOTE.

Messrs Fuller's United Electric Works, Ltd., inform us that their Swansea depot has been removed from Pier Street to more convenient premises at 51 Waterloo Street.

A SOCIAL EVENING.

Members of the staff of Messrs. Peto & Radford held an enjoyable social gathering at the Grosvenor Hotel, Victoria, S.W., on Wednesday, January 7th, when the proceedings took the form of a concert followed by a dance. During the interval appropriate speeches were made by the Chairman and directors.

AMERICAN AND BRITISH RECEPTION IN SYRIA.

A noteworthy attempt to pick up the American and British broadcast transmissions during International Broadcasting week was made at Saad-Nail, near Beyrout, Syria, by Mr. G. H. J. Horan, of the Saad-Nail Observatory. Situated on the slopes of the Lebanon Mountains, and heavily screened by surrounding hills, the observatory was not an ideal spot for the experiments, but the results were distinctly encouraging. On November 26th and 28th, a programme of American origin was heard on between 70 and 80 metres, and probably emanated from KDKA. Heavy atmospherics, however, prevented identification.

The most interesting portion of Mr. Horan's report deals with his reception of the British stations during the relaying of the American transmissions. Fading was very pronounced, but the interesting observation was made that (according to the English announcer) fading from the American station did not coincide with the fading of the British transmission.

A two-valve receiver was used (0—v—1) with a 4-wire cage aerial 114-ft. long, having an average height of 40 feet.

SWEDISH DX WITH AMERICA.

The first amateur two-way communication between Sweden and America was accomplished on December 29th by Swedish SMZS (Teknolog T. Elmquist), and the American 1 CI. The power used by the Swedish station was 150 watts, a wavelength of 80 metres being employed.

BOOK RECEIVED.

Wireless Working Hints for Beginners. By Archibald Williams. (London : Percival Marshall & Co., 66 Farringdon Street, E.C.4.) pp. 94. With 58 illustrations. Price 1s. 6d. net.

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Calls Heard

West Derby, Liverpool.
2 II, 2 IK, 2 MM, 5 BH, 5 GJ, 5 KK, 5 OK, 5 OC, 6 FY, 6 LC, 6 OW, 7 FS, 8 AL, 8 BN, 8 CF, 8 CN, 8 EG, 8 EO, 8 EU, 8 FJ, 8 FK, 8 FM, 8 GJ, 8 JK, 8 OK, 8 QG, 8 SM, 8 SR, 8 SG, 8 WL, 8 WZ, 8 XH, 8 ZM, 8 ZUT, 4 ALS, 4 GP, 0 RW, 0 SK, 0 ZA, 10 KQ. Finnish: 1 NA. (0—v—0.) (John F. Cullen, 5 OL.)

The Hague, Holland.
0 AG, 0 BA, 0 CO, 0 GC, 0 II, 0 GR, 0 RS, 0 RW, 0 ZZ, 1 FP, 2 CC, 2 IN, 2 NM, 2 YT, 3 DAX, 4 RS, 4 UU, 5 TR, 5 UG, 6 AL, 7 ZM, 8 BRG, 8 CM, 8 CO, 8 FI, 8 FK, 8 HSM, 8 PA, 8 QG, 8 RG, 8 TM, 8 UU, 8 VV, 8 WL. (0—v—0.) (T. Zaalberg.)

Kirby Muxloe, near Leicester.
French: 8 AB, 8 AF, 8 DA, 8 DY, 8 FI, 8 FX, 8 GI, 8 GL, 8 GN, 8 SHF, 8 IP, 8 JB, 8 KD, 8 KK, 8 LLO, 8 NS, 8 PA, 8 QG, 8 RBR, 8 RO. Italian: 1 FP, 3 AF. Swedish: SMZY, SMXX. Canadian: 1 AR. American: 1 AAU, 1 AAY, 1 AUG, 1 BKR, 1 CG, 1 CMP, 1 CW, 1 KC, 1 OW, 1 XX, 2 BF, 2 CEI, 2 MU, 2 RK, 3 BG, 3 OGG, 4 OA, 4 TJ, 5 RU. Miscellaneous: 4 RS, 4 YZ, 1 OKZ. Finland: FN 2 NM, FN 2 MB. WGH. (F. H. Tyler.)

1 BDT, 1 BGQ, 1 AYI, 1 CKP, 1 CMP, 10 OP. Miscellaneous: AIN, YA 75, YA 77, 10 KZ, 7 BD, 9 AD, 3 XO, 3 ZP, 3 CM. (0—v—1.) (A. Simons.)

Macclesfield (during last week of November).
8 HSG, 8 AA, 8 DP, 8 EPS, 8 FNN, 8 GST, 9 AD, H 9 AD 13 AF, B 4 QS, A 0 AX (or A 0 AK) calling 8 GST. (Thomas Geeson, 2 SO.)

Stockton-on-Tees.
British: 2 GY, 2 NB, 5 HA, 5 MO, 5 RB, 5 RF, 5 UO, 6 GH, 6 LT, 6 TD, 6 US. French: 8 AB, 8 BRG, 8 BP, 8 CF, 8 CM, 8 DE, 8 DU, 8 EN, 8 EU, 8 FC, 8 FM, 8 GK, 8 GM, 8 GP, 8 HSM, 8 JV, 8 NK, 8 NS, 8 QG, 8 RV, 8 SG, 8 SR, 8 SSC, 8 UU, 8 WAL, 8 WL, 8 WV, 8 WZ, 8 XR, FL, UFT 2. Dutch: 0 BA, 0 GC, 0 II, 0 XF. Belgian: 4 ALS, 4 AU, 4 QS, 4 RS, 4 SS, 4 YZ. Luxembourg: L 0 AA. Germany: 1 CF. Switzerland: 9 AA. Italy: 1 ER. Sweden: SMYY, SMZZ. Finland: FN 1, FN 2 NB, FN 2 NM. American: 1 ANA, 1 BHM, 2 BGG, 2 BSC, 2 CVJ, 4 TJ. Unknown: 1 JXK, 10 KG, 9 BR. (J. W. Pallister, 2 AUH.)

A glimpse in the operating room at B 4ALS, owned and operated by Mr. A. L. Stainier, of Louvain, Belgium.

Braintree, Essex.
French: 8 AB, 8 AQ, 8 AU, 8 BD, 8 BM, 8 BRQ, 8 BV, 8 CN, 8 CZ, 8 DE, 8 DO, 8 DU, 8 EA, 8 EM, 8 EU, 8 FF, 8 FG, 8 FI, 8 FQ, 8 FS, 8 GI, 8 GK, 8 GM, 8 GO, 8 HIM, 8 HSG, 8 HSM, 8 II, 8 LL, 8 MN, 8 ON, 8 PP, 8 SG, 8 SM, 8 SSU, 8 TO, 8 UD, 8 UU, 8 WAL, 8 WV, 8 WZ, 8 XU, 8 ZU. American: 1 AN, 1 BGQ, 1 BX, 1 CA, 1 CMP, 1 II, 1 JXK, 1 KC, 1 PL, 1 XAV, 2 AWF, 2 BY, 2 CG, 2 RK, 3 AJ, 3 AJD, 3 BD, 3 CM, 3 LP, 3 OT. Canadian: 1 AR, 1 DQ. Australian: 3 JU. Danish: 7 EC, 7 ZM. Dutch: 0 AB, 0 BA, 0 GM, 0 IS, 0 ZZ, PA 9. Swedish: SMYY. Italian: 1 AM, 1 DO, 3 AF. Swiss: 9 AD. Belgian: 4 RS, 4 QS, 4 YZ, B 7, P 2. Finnish: FN 2 NM, FN 1 NA. Luxembourg: 0 AA, JXL. Unknown: 3 TO, 3 ZS, 4 AU, 3 EFEE, 4 TRA, 8 ARA, 8 PCA, 8 BGT, Q 8 TH, FZXH, (0—v—1 receiver.) (D. Woods.)

Smedsletten, Sweden.
British: 2 KF, 2 NM, 2 FN, 2 JF, 2 OD, 5 DN, 5 MO. French: 8 AB. Finnish: 2 NM, 3 CM. (B. Fredén.)

Mablethorpe, Lincs.
French: 8 AU, 8 BF, 8 BU, 8 CM, 8 CO, 8 DA, 8 EM, 8 EP, 8 EU, 8 FR, 8 GH, 8 GL, 8 IP, 8 LZ, 8 MR, 8 NS, 8 OK, 8 PA, 8 PP, 8 QA, 8 QC, 8 RG, 8 SM, 8 WL, 8 ZM, 8 LLO, 8 MAR, 8 MTZ, 8 RBR, 8 UMZ, 8 WAL, 8 ZUT. Swedish: SMXX, SMYY, SMZN, SMZQ, SMZY, SMZZ. Dutch: 0 BG, 0 KN, 0 RW, 0 ZA, 0 ZZ. Belgian: 4 GP, 4 RS, 4 QS, 4 UU, 4 YZ. Finnish: 2 NCA, 2 NM, 3 NB American: 1 II, 1 SW 1 YW

UNKNOWN CALLS HEARD.
(Heard at Worksop, Notts.): 8 SSC, LOAA, 2 YT.
(Heard at Ipswich, 28.11.24): JAQ.
(Heard at Lymm, Cheshire, 6.12.24): S 7 BD.
(Heard at Brixton): 6 RM.
(Heard at Dingwall, N.B.): A 3 ZY.
(Heard at Wooler, Northumberland): 7 GQL 2, 7 GQL 3, O 8 LL.
(Heard at Queenstown, Ireland): UK 9 AB.
(Heard at Weybridge, Surrey), E 1 CM.

UNKNOWN CALLS.

The following information concerning unknown calls, recently published in this journal, is forwarded by Mr. R. E. Williams, of Holyhead.

"AIN is situated in Casablanca, Morocco, and belongs to the French Army Signal Corps, and works on a W/L. of approximately 50 metres. This information was supplied to me by F 8 BF last July, at which time he was conducting short wave experiments with AIN on 44 metres.

"I have also observed that a station with the prefix YA with different figures following, is published practically every week as received amongst the unknown calls by different amateurs, and this has been going on for some months now, and the figures following the YA are always different and has gone up from YA 1 to YA 77. I heard this station once give his position as "Penzance, South of England." So probably he is enjoying the fun of seeing reports published in your journal, and also finding just how far his signals can be heard, thus wasting the time of experimenters who would otherwise be doing real D.X. work."

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AMONG THE SOCIETIES.

[*Correspondence intended for Club Secretaries may be addressed c/o the Editor of this Journal.*]

During the last two months junior members of the Wimbledon Radio Society have been able to profit from a series of elementary lectures on wireless by Mr. C. E. P. Jones. All lectures have been illustrated by specially prepared diagrams thrown on the screen by a reflecting lantern.

Mr. J. A. Partridge (2 KF) recently paid a surprise visit and provided an interesting account of his DX work with New Zealand amateurs.

Captain P. P. Eckersley is to lecture in the Compton Hall, Wimbledon, on Thursday, January 29th.

A nominal admission fee of 6d. will be made, the proceeds to be devoted to the Wimbledon Hospital.

* * * *

The Ilford and District Radio Society's recently constructed portable receiver is yielding excellent results on a short indoor aerial. Comprising four valves, the set is arranged to work on any combination of valves from one to four. For the construction of the receiver the Society is indebted to the Hon. Secretary, Mr. Gedge.

The Society is at present running an instructive competition in connection with which prizes are offered for various types of set built by members.

* * * *

The new session of the Holy Trinity (Barnsbury) Radio Club opens on January 16th. All radio enthusiasts over 16 years of age, residing in the Barnsbury district, are invited to attend the club meetings during the new session, which closes on May 22nd.

* * * *

The subject of "Aerial Tuning" was dealt with in an informative lecture given before the Beckenham and District Radio Society by Messrs. Igranic, Ltd., on January 1st.

An excellent programme of meetings has been arranged for the present session, and intending members should communicate with the Hon. Secretary without delay.

* * * *

At the last meeting of the Dorking and District Radio Society, Mr. L. F. Cooke gave the first of a series of elementary lectures on the underlying principles of wireless. These lectures, primarily intended for beginners, are held on the third Monday in each month. The next lecture will deal with wireless components.

* * * *

The Hackney and District Radio Society continues its useful series of "Vest Pocket" lectures. One of these recently given by Mr. Jones dealt with his interesting experiences in the nightly reception of KDKA. Mr. Van Colle gave an interesting talk on switching arrangements, and Mr. Phillips contributed with an explanation of how to determine the correct value of the filament resistance for any type of valve.

* * * *

A visit to 2 LO was paid by members of the Woking and District Radio Society on December 31st, an enjoyable and instructive afternoon being spent in the inspection of the apparatus and studios. The Society extends a warm welcome to new members.

FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 14th.

Radio Society of Great Britain. Informal Meeting. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. "Some Notes on Short Wave Reception." By Mr. Stanley Ward.

Clapham Park Wireless and Scientific Society. At 7.45 p.m. At 67 Balham High Road. Lecture by representative of Alfred Graham & Co.

THURSDAY, JANUARY 15th.

Luton Wireless Society. At 8 p.m. At the Hitchin Road Boys' School. Experiment and Demonstration for Beginners.

Bournemouth and District Radio Society. Lecture: "Brown Apparatus: its Construction and Working." By Messrs. S. G. Brown, Ltd.

Woking and District Radio Society. At 7.30 p.m. "Valves." By Messrs. The Mullard Radio Valve Co., Ltd.

FRIDAY, JANUARY 16th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Department of Applied Science, St. George's Square. Lecture "A.C. Rectifiers." By Mr. C. H. Hainsworth.

Holy Trinity (Barnsbury) Radio Club. At 7.45 p.m. At Parish Hall, Richmond Road, Islington, N.1. Opening Meeting of Session.

MONDAY, JANUARY 16th.

Dorking and District Radio Society. At 7.45 p.m. At 65 South Street. Members' Evening with apparatus.

QSL CARDS WAITING.

The British amateurs 2 AWD, 2 GY and 2 XE are asked to communicate with the editor of the *Journal des* 8 (Imprimerie Veuclin, Rugles, Eure, France), who is in possession of QSL cards intended for these amateurs.

MISUSE OF CALL SIGNS.

Mr. Norman Blackburne (2 AJB), of Hastings, has reason to suspect from reports received, that his call sign is being used illicitly in the Stockport (Manchester) district. As 2 AJB is licensed only for an artificial aerial, misunderstandings are likely to occur with the authorities, and he trusts that the publication of this note will have the desired effect.

A similar case is reported by Mr. William H. Neeld (2 ARB), of Wanstead, E.11, whose licence is for an artificial aerial. Signals from a station using his call sign are reported from the Bath district.

The unauthorised use of the call sign 2 AW, is reported by its owner, Lieut.-Commander Burbury (R.N., Ret.), of Crigglestone, Wakefield. 2 AW has not been in operation since March last.

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READERS PROBLEMS

Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

CHOKES FOR L.F. AMPLIFICATION.

MANY readers have written asking what is the most suitable value of choke to employ in choke-coupled amplifiers.

In order to secure pure reproduction with the choke method of amplification, the inductance of the choke must be sufficiently large to offer a high impedance to the lowest musical frequencies which the amplifier is required to deal with. A suitable value of choke is one having an inductance of 100 henries.

The windings of an ordinary intervalve transformer, when connected in series, are excellent for this purpose. If chokes of too low a value are used, distortion of the lower frequencies will occur.

In order to obtain a reasonable degree of amplification per stage a valve having a high amplification factor should be employed. Such a valve is the D.E.5 B. In cases where very great strength is expected to be delivered to the grid of the last valve of a choke-coupled, or, in fact, any type of amplifier, a valve of the L.S.5 type should be employed, as this valve has a long characteristic curve, and is capable of dealing with large power without distortion.

THE ELIMINATION OF NOISES DUE TO MAGNETIC INDUCTION.

SEVERAL correspondents have asked us whether we consider that the "bird-cage" type of aerial mounted on a single pole is suitable for the elimination of interference caused by the proximity of tramways.

This type of aerial is only effective for the purpose named when it can be definitely proved that the interference is caused by direct induction from the overhead trolley wires or the underground conduit such as is likely to be caused if the ordinary type of aerial running parallel to the roadway is used. This can be cured in many cases by running the aerial at as large an angle as possible to the roadway. In cases where this is impossible, however, the "bird-cage" type of aerial may be tried since no part of it will be parallel to the tramway conduits. It has, however, been our experience that most of the trouble which readers meet with from this cause is due to earth currents and not to magnetic induction. In these cases, of course, no advantage would be obtained by the use of this type of aerial and in order to eliminate this interference various expedients can be tried such as the connection of a condenser of large capacity, say 2 μF, in the earth lead. Failing this it will be necessary to employ a counterpoise in the manner suggested in the last issue.

A RELIABLE VARIABLE GRID LEAK.

A CORRESPONDENT has written asking us to suggest a suitable method for constructing a variable grid leak.

It is not to be recommended that home-made grid leaks of the ordinary type be employed in wireless circuits. Excellent results may of course be had when wiring up experimental circuits by using leaks of the pencil mark type, but these are naturally quite unsuitable for incorporating into finished receivers. It will usually be found that leaks of the carbon compression type will invariably give trouble in the long run due to "packing," and even in the commercial types it is seldom that the resistance value for a given setting of the adjusting knob remains constant for any given length of time.

The case is quite different when dealing with fixed leaks made by reputable firms as their value can usually be trusted to remain constant provided that they are not brought into contact with a hot soldering iron, or similarly ill-used. It is noteworthy in this respect that so far manufacturers of these highly reputable components have not attempted to produce a variable grid leak, they apparently realising the difficulties in accomplishing this end. Bearing in mind, however, the extreme reliability of the fixed type of grid leak it would seem that the most reliable form of "variable" leak which could be made by the home constructor would be of the kind where connections from a number of fixed leaks are brought to a series of studs on the panel and brought into circuit by means of the usual rotary switch. For instance, two grid leaks of ·5 megohms resistance value could be used singly or placed (by means of the stud switch) into series or parallel with each other, thus obtaining values of ·25, ·5 and 1 megohm. The simplest way of course, would be to employ nine studs with nine leaks attached thereto, increasing in value from ·5 megohm to 5 megohms by half-megohm stages. This would give sufficiently fine adjustment for all ordinary purposes and would be remarkably simple in construction. If finer adjustment is required, a switching arrangement containing two sets of studs may be employed in order to enable various combinations of leaks in series and parallel to be used for obtaining intermediate values. For instance, in order to obtain a value of ·25 megohms, two leaks of ·5 megohm each could be used in parallel, whilst if an additional leak of 1 megohm

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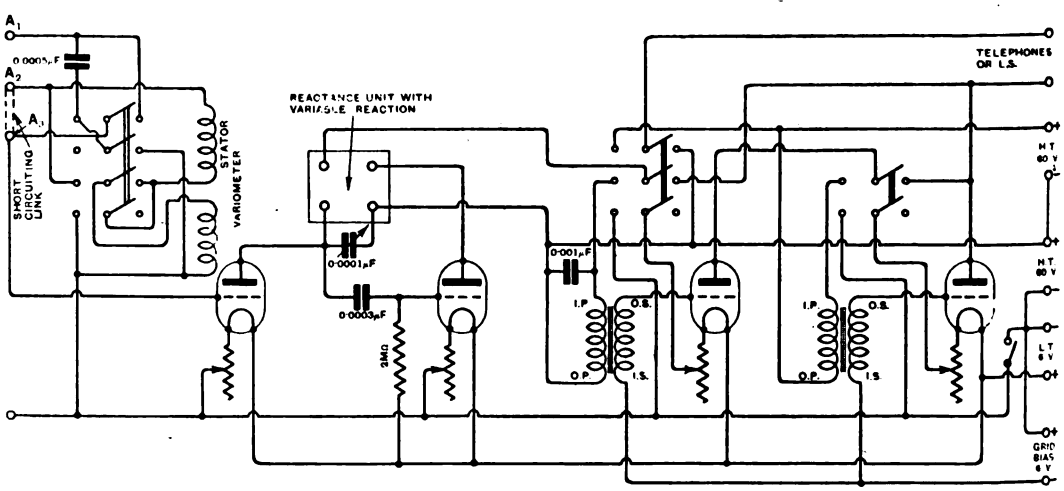
were placed in parallel with these the resultant value would be ·2 megohms. These leaks should preferably be mounted in clips at the back of the panel, partly owing to the harmful effects caused by the careless application of a hot soldering iron and partly because a defective specimen is easily replaceable. In some foreign countries it is possible to obtain a component of this description, the usual practice being to bring a number of leaks of different values into circuit by means of a simple stud switch and a variable leak having a range of only ·5 megohm can be brought into series with the fixed leaks when superfine adjustment is required. The variable element, by reason of its extremely small range, is usually reliable and very fine adjustment is obtainable by means of a worm gear.

grid bias and extra high tension for the L.F. amplifiers are included in order that two power valves may be used here if desired. The tripolar switch automatically adjusts the voltage applied to the anode of the detector valve when the telephones are brought into this circuit.

The extra H.T. and the grid terminals may be short-circuited if desired, and ordinary valves used for low frequency amplification, but, of course, at some sacrifice of purity of reproduction.

It will be noticed that three aerial terminals are provided. Normally the two lower ones should be connected together, and the aerial attached to the top one. Should it be desired to use a frame aerial the connection between the two lower aerial terminals should be removed, and the frame attached either to these two terminals or between the top two.



A four-valve receiver with switches to control the number of valves in circuit. A variometer is employed for tuning the aerial circuit and a tapped reactance unit couples the H.F. and detector valves.

A FOUR-VALVE RECEIVER SUITABLE FOR EITHER LONG OR SHORT WAVE RECEPTION WITHOUT THE USE OF PLUG-IN COILS.

A READER has written asking us for a circuit suitable for covering the B.B.C. and main continental band of wavelengths, and also Chelmsford and the long-wave Paris stations. He asks if it is possible to accomplish this without resorting to plug-in coils by using a variometer and an anode reactance and variable reaction unit which he has in his possession.

We illustrate above a circuit suitable for accomplishing this. Switches are provided for cutting out either one or two L.F. valves as desired. No provision is made for cutting out the H.F. valve, since, in this particular circuit reaction cannot be employed unless this valve is in circuit, and the detector valve alone would give a range not greatly in excess of that given by a crystal. Terminals for

With the four-pole range switch in the short wave position the rotor and stator windings of the variometer are placed in parallel and a 0·0005 μF fixed condenser inserted in series. According to data given by the manufacturers of the components in question, this arrangement should cover from about 250 metres to well above the broadcast range. Upon changing over to the long wave position the variometer windings are placed in series and the 0·0005 μF fixed condenser is placed in parallel across the whole aerial circuit. It will then be possible to tune in the long wave Dutch stations, and also Chelmsford and Paris. The anode reactance, of course, easily covers both long and short waves.

This circuit will be found quite stable and productive of excellent results on either the local or more distant stations, and the tuning will be considerably easier than with the usual type of tuned anode circuit.

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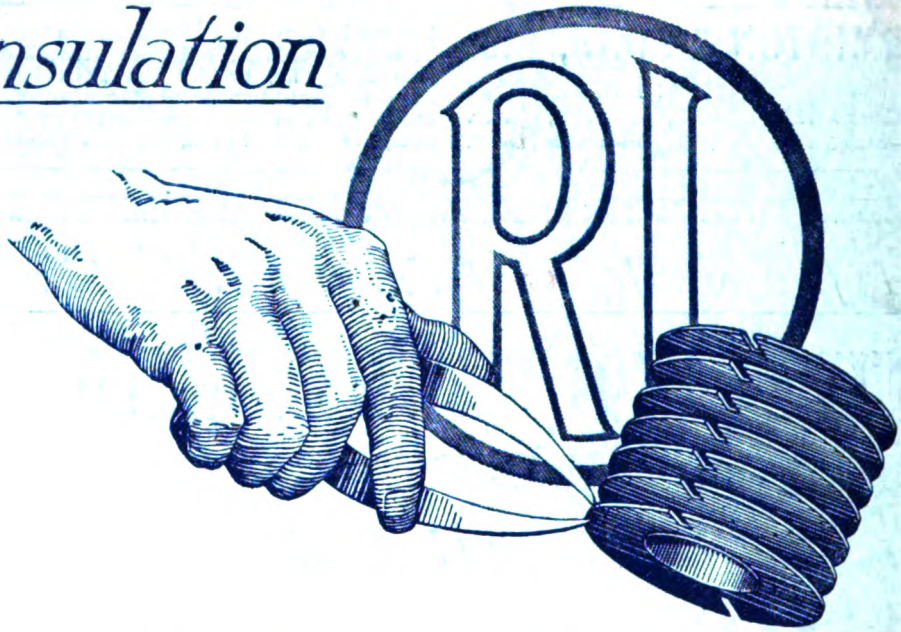

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

By The Editor.

CAN THE OSCILLATION NUISANCE BE REMEDIED ?

ON turning over the pages of a daily newspaper which enjoys an extensive circulation, one's attention is drawn by a headline "Station Shooting." Headlines often convey very little and on reading down the column one learns exactly what this arresting title means.

A reader there describes his experiences in an attempt to receive the transmissions of as many broadcasting stations as possible, and one sees, not without surprise, that the aim of the writer is to encourage readers to search out the signals of distant stations, paying very little attention to the programme transmitted by the local station. If this suggestion is acted upon seriously, interference by oscillation will increase enormously, and the advice that we have frequently given to broadcast listeners that they should tune in a local station and then leave the dials alone will, as a result, be ignored. In view of this it is as well to draw attention to the urgent need to deal with the question of interference by oscillating receivers.

The "Don't do it" policy of the B.B.C. has served no purpose. We fail to see how a non-technical listener equipped with receiving apparatus built probably by a firm of manufacturers who are themselves members of the Broadcasting Co., and fitted with adjustable reaction, can be tuned without causing interference. Such a set will energise the aerial circuit whenever the reaction coil is brought into operation, and we do not know of any instructions that could be issued to a listener who has no technical knowledge, advising him as to the method to be adopted in tuning his receiver to avoid the setting up of self-oscillation.

The Post Office, on the other hand, went into the matter to the best of its ability, and as we all remember, undertook the testing and stamping of all receivers to be sold for broadcast reception. Although these sets made use of reaction in a variety of ways the Post Office liberally issued an authority stamp certifying that certain receivers would not cause serious interference. To attempt to do a thing of this sort does not reflect great credit on those technical men who were prepared to take upon themselves such a responsibility, and after being in operation for many months the Post Office now withdraws control and permits manufacturers to build self-oscillating receivers just as they please. In the case of the experimenter the Post Office shifted the responsibility and in awarding a permit the would-be experimenter was told that he must not use his apparatus in a manner that would energise the aerial circuit, though they did not go as far as to say that he was not to make use of reaction. They would have been fulfilling their duty if they had drawn up just one circuit that would meet this requirement. Personally we have not seen such a circuit published as yet. Members of the Radio Society will remember that shortly after the war the question of interference by oscillation was carefully debated and of all the circuit systems put forward none was found to be non-interfering.

Local radio societies have been faced with definite complaints, mainly because the Broadcasting Company, in their dilemma have shirked the job and recommended those experiencing trouble to get in touch with their local society. The societies have done their best to deal with complaints and to endeavour to find remedies, but operating in a small area and without advice their efforts have been without avail. Were it possible to locate an interfering

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station what steps should the investigators take to prevent continuance of the nuisance? They may inform the user that his set makes use of reaction, and therefore is certain on most of its adjustments to cause interference, and they may recommend him to abandon his expensive outfit. But why should the offender be so penalised and his signal strength reduced, while the law permits the sale and construction of oscillating receivers?

Almost every valve user unblushingly adjusts his reaction coil. The receiving set may whistle when it oscillates by becoming sensitive to the oscillations of a neighbouring set, or the user may adjust to that silent point where he tunes in KDKA at maximum strength. In either case the range of his set as a transmitter may be tens of miles.

The oscillation nuisance must be stopped, for we believe that even to the crystal user whose non-oscillating set does not respond to the continuous waves emitted by interfering sets, appreciable distortion must be produced in the quality of the broadcasting received. Some thousands of oscillating receivers in a congested area must create strains in the ether of infinitely greater intensity than even the broadcasting stations themselves, and the effect produced is probably a falling off in range, quality, and signal strength, apart from the annoying heterodyne squeals to which the oscillating set is so responsive when tuned to the wavelength of another oscillator.

As an immediate remedy we would suggest that the general public be discouraged from searching for distant stations on the British broadcasting wavelengths. There is little doubt, however, that the only real remedy lies in the prohibition of the use of reaction during broadcasting hours, and on broadcasting wavelengths, and it is here that the experimental licence would have been so useful inasmuch as the skilled worker would have enjoyed full facilities, making use of his knowledge in the manipulation of his set, and knowing whether or not interference is being caused. To forbid the use of reaction is rather a bold suggestion, we admit, but we believe that in this direction may lie a solution to the present chaos.

The columns of this journal are available for the expression of readers' views and we would welcome suggestions which may lead to a possible solution.

BROADCASTING AND THE THEATRES.

THE strong feeling of theatrical managers over the question of broadcasting plays is not likely to have been lessened by the recent transmission of part of the revue "Yoicks," from the Kingsway Theatre. The interest which the press took in the matter very naturally induced a larger public to listen in for that transmission than would have otherwise been the case, and it seems most unlikely that anything but benefit to the theatre and the play can come of this publicity. In fact the announcement of other similar events comprises this. The quarrel is no new one and has been in existence ever since broadcasting first started, when at that time there was also some risk of unfriendly feeling between broadcasting interests and the press. However, those difficulties were overcome early in the negotiations, which prepared the way for organised broadcast in this country. We would very much like to see a concise statement by the theatrical interests pointing out just in what way they consider that the broadcasting of plays can be detrimental to their interest. As near as we can recollect, an unfortunate circumstance in the early days of broadcasting may be in part responsible for the present antagonistic attitude. We refer to the exclusion, whether accidental or otherwise, of representatives of the theatrical profession from the earliest negotiations, in conjunction with the Post Office, which prepared the way for broadcasting. The press was strongly represented then and a good many other interests, so that it is possible that the seed of discontent was sown at that time. Now, it almost seems as if the Broadcasting Company is to get its own way simply by force of public opinion and one cannot blame the Company for taking whatever steps it can to bring about the addition to its programmes of whatever is demanded by the public, but at the same time it remains a matter of regret that it has not been possible up to the present for broadcasting and theatrical interests to come to a better understanding, and we wish all success to the pending discussions between the parties which we understand is about to take place.

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TELEVISION.

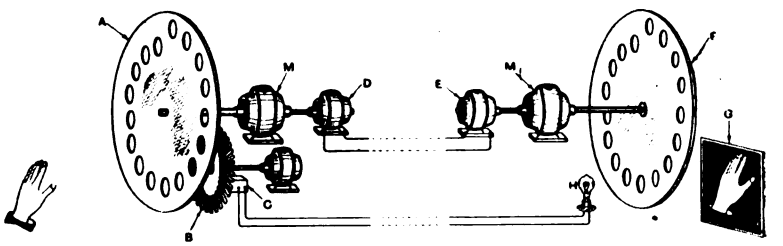
A DESCRIPTION OF THE BAIRD SYSTEM BY ITS INVENTOR, J. L. BAIRD.

IN the issue of *The Wireless World and Radio Review* for May 7th of this year, an account was published describing some of my early experiments in television when moving shadowgraphs were transmitted. A further account of developments which have since taken place may be of interest to wireless workers and enthusiasts, as television, although it can scarcely be described as a branch of wireless telegraphy, is closely allied to it.

For instance, one of the first problems to be faced in television is the amplification of the extremely minute current given by the light-sensitive cell. The thermionic valve has provided a solution to this problem by giving us a means of amplification to almost any extent; this is only one of the many wireless devices used in television.

The distinction between the transmission of shadowgraphs and that of actual objects is much greater than is at first apparent. With shadowgraphs the light-sensitive cell is only called upon to distinguish between total darkness on the one hand and the full power of the source of light, possibly several thousand candle power, on the other.

In the transmission, however, of actual objects, even where only black and white are concerned, the cell has to distinguish between darkness and the very small light, usually, indeed, only a small fraction of a candle power, reflected from the white part of the object. The apparatus has therefore to be capable of detecting changes of light, probably at least a thousand times less in intensity than when shadowgraphs are being transmitted. There are other optical pro-



Diagramatic Plan.

For simplicity, two sets of line wires are shown. In sending by wireless the high frequency light signals are superimposed on the low frequency synchronising signals.
A and F = Lens Discs. B = Serrated Disc. C = Light Sensitive Cell.
D = A.C. Generator. H = Lamp. G = Receiving Screen.

In the earlier models shadowgraphs only were transmitted, the light having to be *behind* the object sent. The utility of a machine capable of transmitting only shadows is obviously restricted, and the next step to be attempted was the transmission of an actual object by *reflected* light.

blems which render the transmission of the actual object much the more difficult of the two, but the above is sufficient indication of the difficulty of the step.

The apparatus now used consists of a revolving disc containing a single spiral of lenses, and, behind this, a serrated shutter

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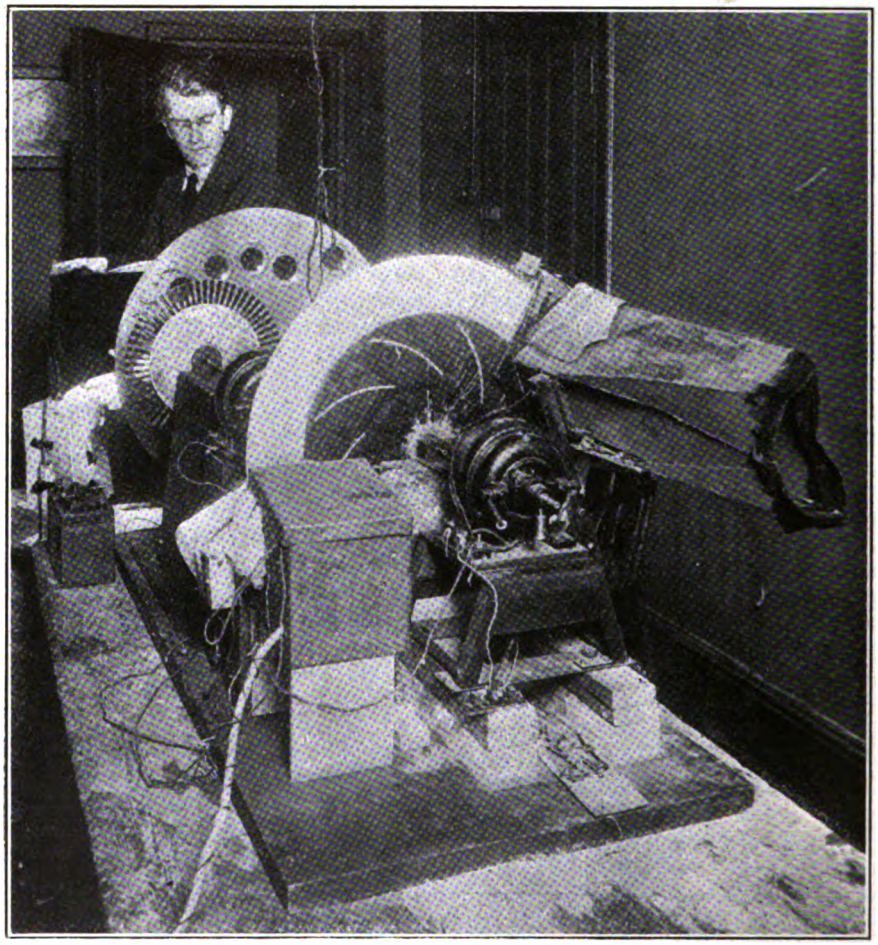
revolving at a very high speed. The object to be viewed is placed in front of the disc, which revolves at about 500 revolutions per minute. The arrangement will be better understood by referring to the accompanying drawing. The hand is the object being transmitted. As the disc revolves, light from every part of the hand falls in succession on to the light-sensitive cell "C" after having been interrupted at very high frequency by the serrated disc "B." This interrupted light, as it falls upon the cell, gives rise to a pulsating current in its circuit. The pulsating current, after amplification, is transmitted to the receiving machine, which consists of a disc containing a spiral of lenses exactly similar to the disc at the transmitting end, and revolving in synchronism with it. Behind this disc, in a position corresponding to that of the light-sensitive cell at the transmitting station, is a lamp which is fed by the received current. The varying light from this lamp traverses a ground glass screen and reproduces there the hand which is being transmitted.



End view of transmitting machine. Mr. Baird in the background is holding his hand in position for transmission in front of the lens disc. Part of the old machine used for the transmission of shadowgraphs is seen in the foreground.

The method of synchronism, which was not described in my previous article, is simple. Isochronism is obtained by coupling a small A.C. generator to the transmitter shaft and the current from this being trans-

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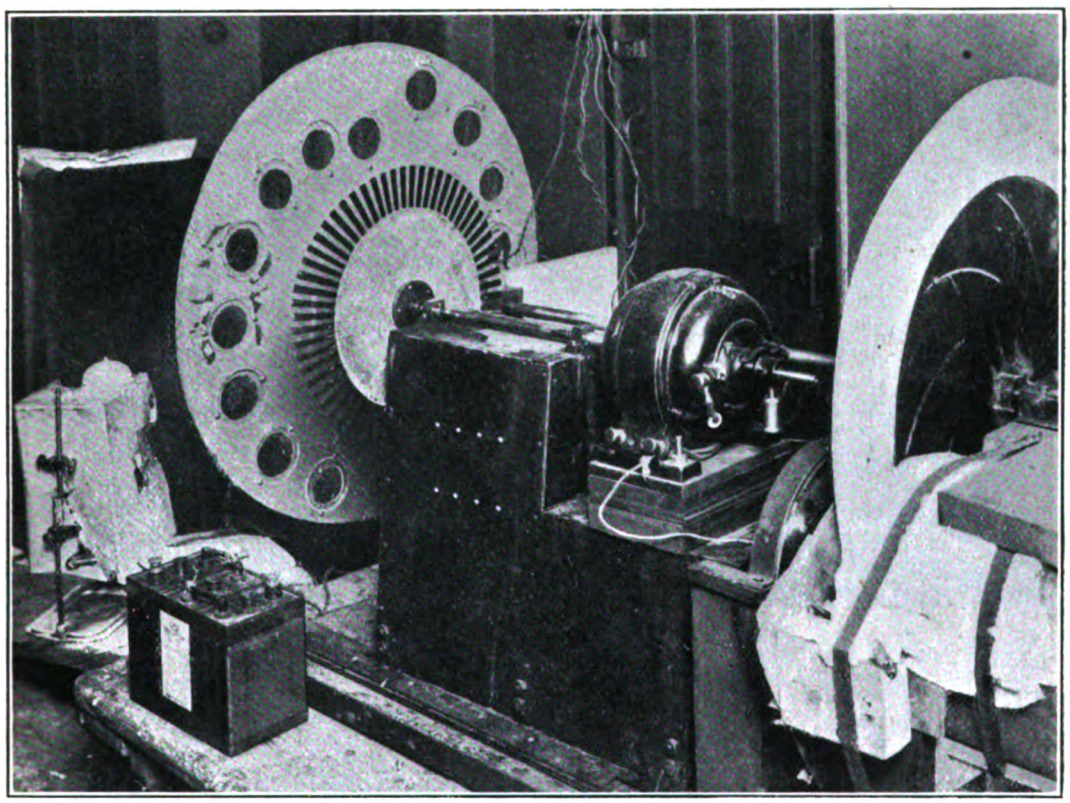
mitted to the receiving station where it controls an A.C. synchronous motor. Only a very small current is required.

Synchronism is obtained by rotating the synchronous motor about its spindle or bodily rotating the driving mechanism until the picture comes into view.

The letter " H," for example, can be clearly transmitted, but the hand, moved in front of the transmitter, is reproduced only as a blurred outline. A face is exceptionally difficult to send with the experimental apparatus, but, with careful focussing, a white oval, with dark patches for the eyes



Side view of transmitter showing spiral arrangement of lenses and serrated disc. The light-sensitive cell is contained in the metal case behind the serrated disc.

The cell which I have been using is neither a photo-electric nor a selenium cell, but a colloidal (fluid) cell of my own invention, of which I hope to give particulars at a later date.

At present the apparatus is one constructed purely for experimental purposes, and is capable of transmitting only simple objects. and mouth, appears at the receiving end, and the mouth can be clearly seen opening and closing.

There have been many suggestions that television should be allied to the kinema. This opens up a wide vista for the future, but it is early yet to speculate upon the matter.

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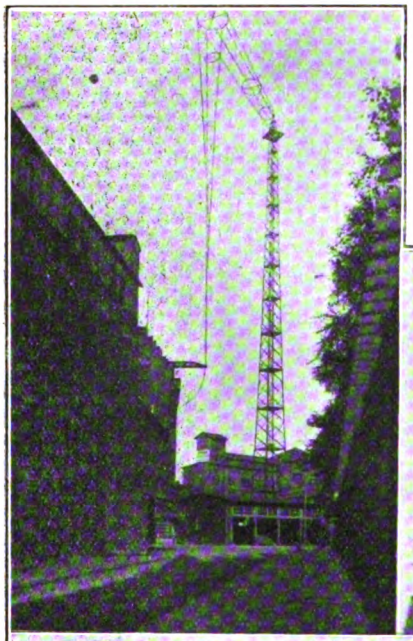
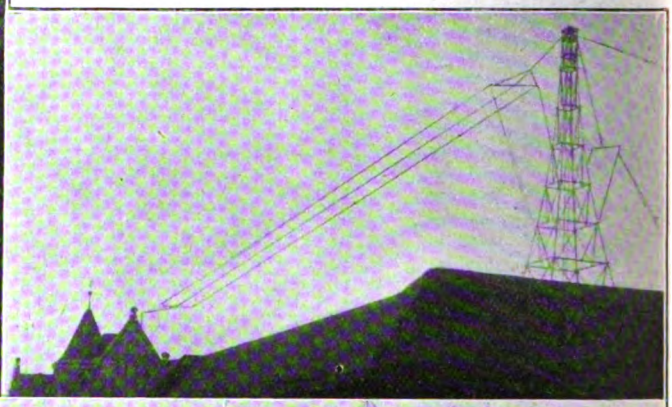
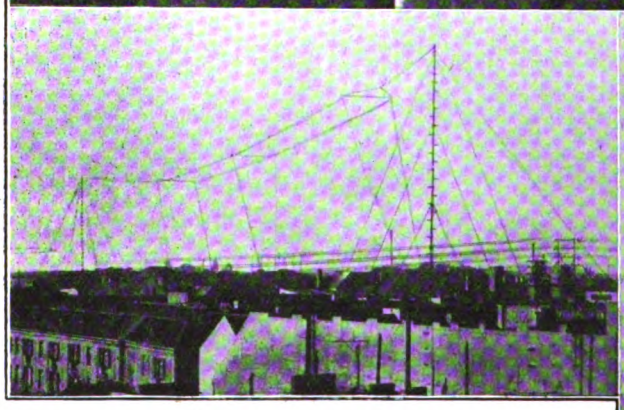
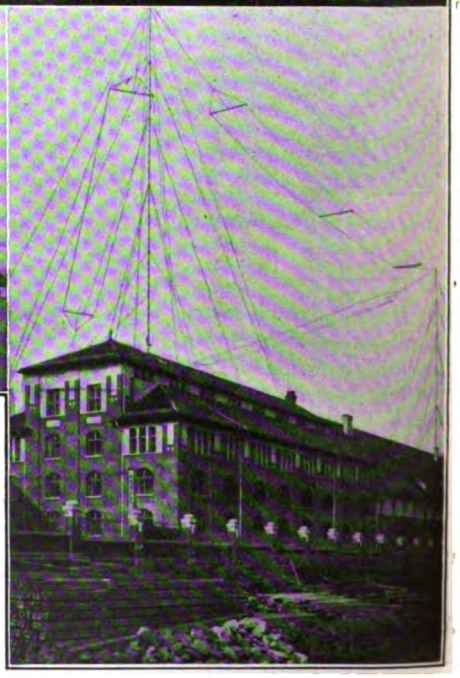
BROADCAST AERIALS IN GERMANY.

Left, the aerial and one of the towers of the Münster broadcasting station, which conducts daily transmissions on a wavelength of 410 metres; below, the aerial of the München station, operating on a 485 metre wave. Both these stations transmit afternoon and evening concerts every weekday, whilst a short afternoon concert is also given on Sundays. The Münster station is operated by the Westdeutsche Funkstunde A.G., whilst the München station belongs to the Deutsche Stunde in Bayern.









The site of the 505 metre station in Berlin is shown in the picture above, whilst the building which carries the Stuttgart masts and aerial is shown on the right. This building also houses the studio and the transmitter.

The wavelength of the Stuttgart station is 443 metres, and the station belongs to the Suddeutsche Rundfunk Aktiengesellschaft.

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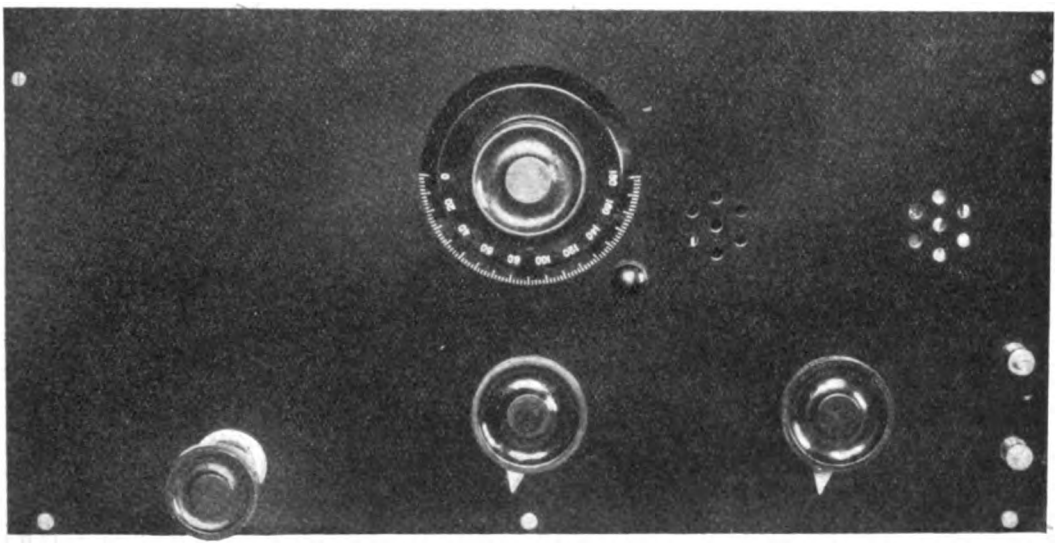
A TWO-VALVE RECEIVER

DETECTOR AND NOTE MAGNIFIER



Where plug-in coils are employed for tuning it is usual to fit the coil-holder to the outside of the set. Now that coil-holders of the type used in this receiver are available, it is convenient to accommodate the coils behind the panel. The following article describes a two-valve receiver making use of this feature.

By HUGH S. POCOCK.

IN spite of the multiplicity of designs for receivers and the almost inexhaustible variety of circuits which can be employed, there still remains a simple circuit which has not lost in popularity through the introduction of so many competitors. The combined detector and one stage low frequency amplifier (Fig. 1) still maintains its popularity amongst amateurs throughout the world. Such a receiver is used by nearly all amateurs as a general standby set, and daily records of long distance reception are sufficient to indicate that its efficiency leaves little to be desired in the hands of a careful operator. It has, moreover, the advantage that it is comparatively simple to operate, and therefore searching for long distance stations can be done without much difficulty. When skill has been acquired on a receiver of this type it is surprising how little is missed of any signal capable of reaching the aerial. It would be out of place here to enter into the controversy which is still going on amongst amateurs as to whether a circuit of this type can rival super heterodynes and other more elaborate receivers. No doubt the super heterodyne can give much better results when properly designed and handled, but it is often much more a matter of skill in the operation of a receiver than the type of circuit used which accounts for the extra-

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ordinary achievements in long distance reception which have been recorded in this journal during past months.

The purpose of describing the present receiver is to give a convenient and compact

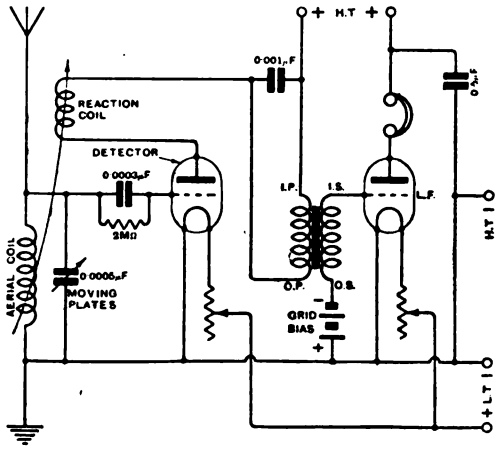

Fig. 1. The theoretical connections of the receiver.

design for using plug-in coils with a two-valve circuit so that the receiver may be a standby for the use of the general amateur, whilst it is also a convenient arrangement for use for broadcasting, and at reasonable ranges will give good loud speaker strength without resorting to pushing reaction to the point of producing interference.

CONTROLS ON PANEL.

The controls for tuning as shown in the photograph of the front panel are two, one being the variable condenser across the aerial coil and the other the knob for adjusting reaction coupling. The two filament resistances are the only other controls to manipulate. A feature of the arrangement is the employment of a type of coilholder which is suitable for behind panel mounting, so that the plug-in coils can be accommodated behind the panel instead of being fitted, as is more usual, but rather clumsy in appearance, on the side of the box housing the set. This type of coilholder gives a neat appearance to the finished receiver, whilst in addition it gives particularly easy adjustment with one control. The type of variable condenser used is one giving a vernier adjustment, but without the employment of an aditional vernier condenser plate.

LIST OF PARTS REQUIRED.

The list of parts required for the receiver is a small one, and the cost is also proportionately small. No expensive components are made use of, and the wiring and general construction is of the simplest. The following components will be required :—

1 Ebonite panel, 7 ins. by 14 ins., which is a standard size for Radion panels if the constructor desires to make use of one of these.

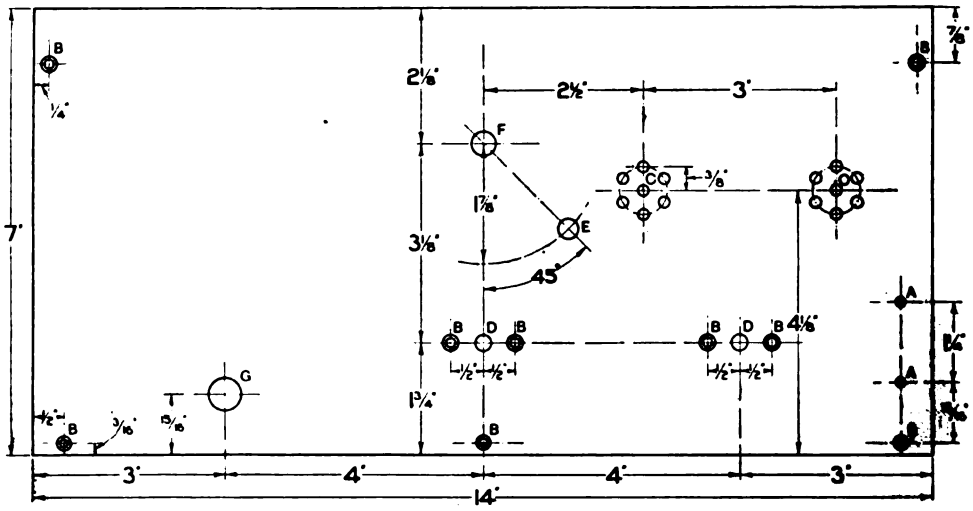

Fig. 2. A drawing of the ebonite panel showing the position of the components. The holes have the following sizes :—A, drill 5/32 in. hole for 4 B.A. terminals. B, drill 5/32 in. hole and countersink for No. 6 wood screws and 4 B.A. countersunk screws. C, drill 3/16 in. hole. D, drill ¼ in. hole. E, drill 5/16 in. hole. F, drill ⅜ in. hole. G, drill ½ in. hole.

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1 Variable condenser, 0·0005, which in this particular instance is of the pattern supplied by Jackson Bros., and known as "J. B."
1 Two-coil holder for mounting behind the panel ("Ellanpee").
2 Valve holders.
2 Filament resistances (Ormond).
1 L.F. transformer.
1 Grid condenser, with clips for grid leak, having values of 0·0003μF and 2 megohms respectively.
1 Fixed condenser of capacity 0·001 μF.
1 Fixed condenser having a capacity of 0·5 μF for use across the terminals of the H.T. battery.
1 Three-cell dry battery for providing negative bias to the grid of the second valve.
9 Terminals, two for mounting on the front of the panel for the telephones, and seven at the back of the panel on a strip of ebonite, size 7 ins. by 1$\frac{3}{8}$ in., as shown in the illustration.

in the drawing (Fig. 2), where all the dimensions of holes are given. It will be seen that both the variable condenser and the two-coil holder fitted to the panel are of a

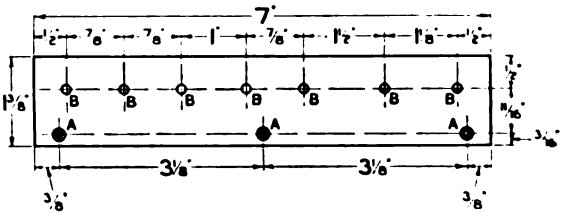

Fig. 4. Details of the ebonite connection strip. A, ⅛ in. dia., countersunk for No. 4 wood screws B, 5/32 in. dia.

type using one-hole fixing. For the filament resistances, of Ormond pattern, three holes will be drilled to the sizes shown in the drawing, two of the holes being used for the screws fixing the resistances to the panel. The remaining holes to be drilled in the panel are those for the telephone terminals, for fixing

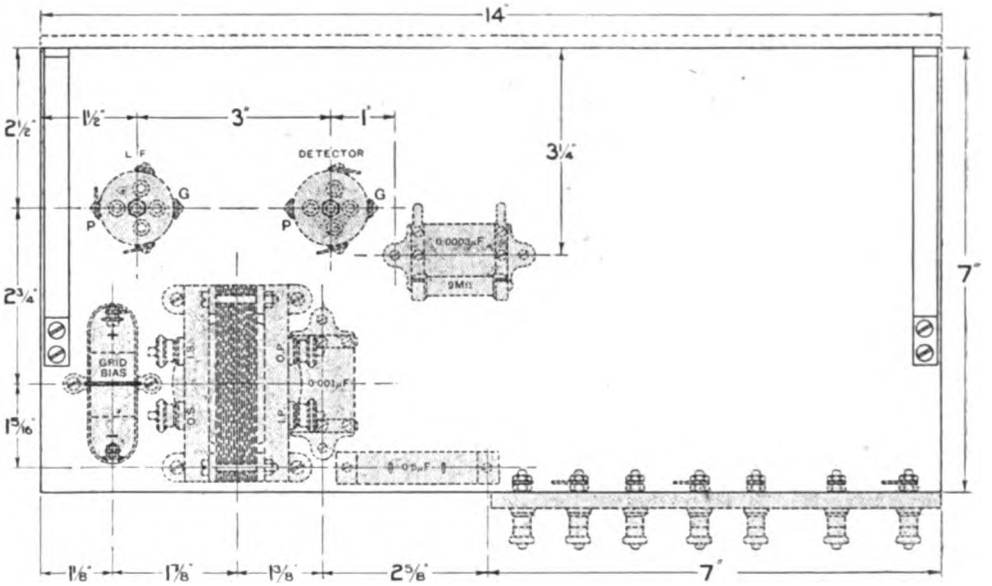

Fig. 3. The arrangement of the components on the baseboard.

1 Wooden baseboard, size 7 ins. by 14 ins., on which all components, except those which are actually fitted to the front panel, are attached.

Assuming that components of the type mentioned above are purchased, the drilling of the panel can be done precisely as indicated

the panel to the wooden baseboard (Fig. 3) by means of wood screws, and the screw holes for fixing the brass brackets, which support the panel. In addition, if desired, holes may be drilled through as shown to provide peep holes through which to see when the valves are lit if the set is housed in a box.

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The terminal strip (Fig. 4) is screwed to the back edge of the baseboard so that it will come flush with the outside of the box in which the receiver may be contained. Three terminals are provided for H.T. battery

stages is employed such as the B.T.H. B 4. The three-cell dry battery provides a negative bias of $4\frac{1}{2}$ volts, and the H.T. potential may then be 120 volts. A fixed condenser of 0·001 μF capacity is employed

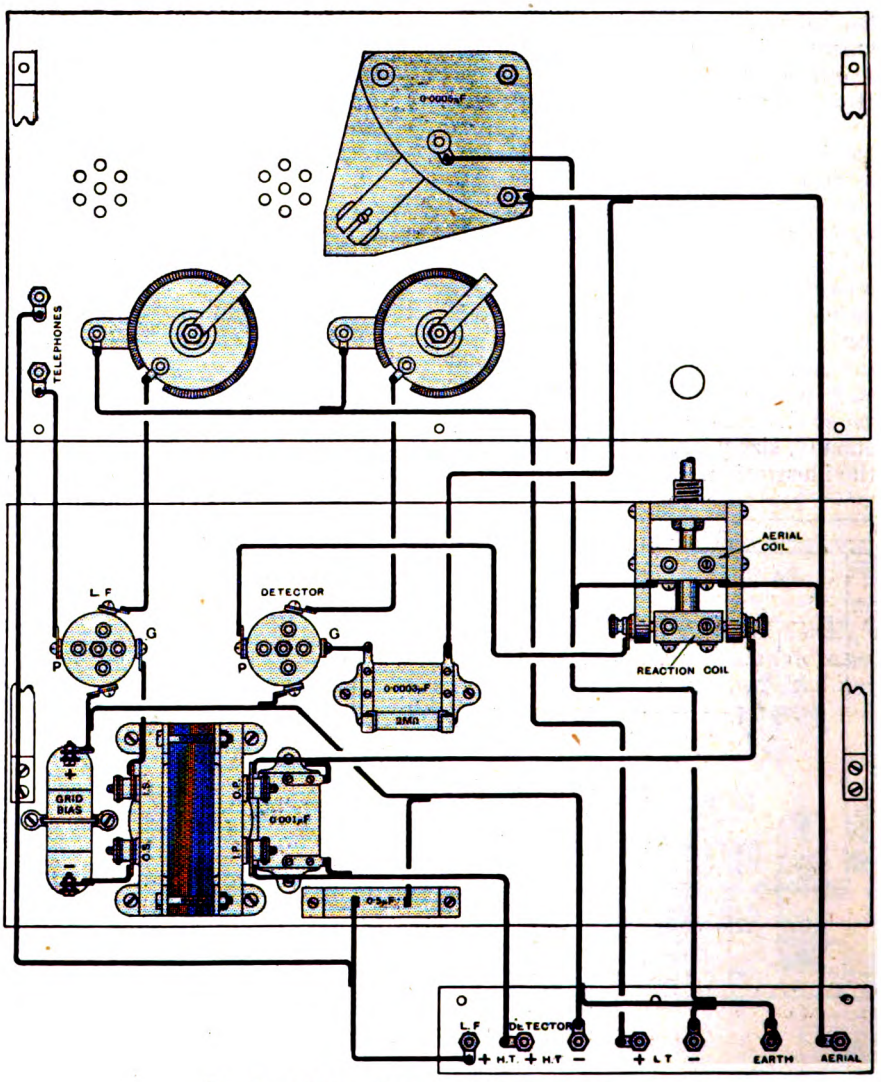

Fig. 5. Wiring diagram of the receiver.

connections; one is the common negative, and the other two are provided in order that additional potential can be applied to the plate of the second valve. Although an "R" type valve would function satisfactorily in the L.F. stage, it is better if a valve of a type specially designed for low frequency across the primary of the low frequency transformer, which in this instrument is of the R.I. pattern.

After the components have all been placed and fixed, the wiring can be proceeded with, and for this Fig. 5 should be carefully followed. The wiring should be done with bare No. 16

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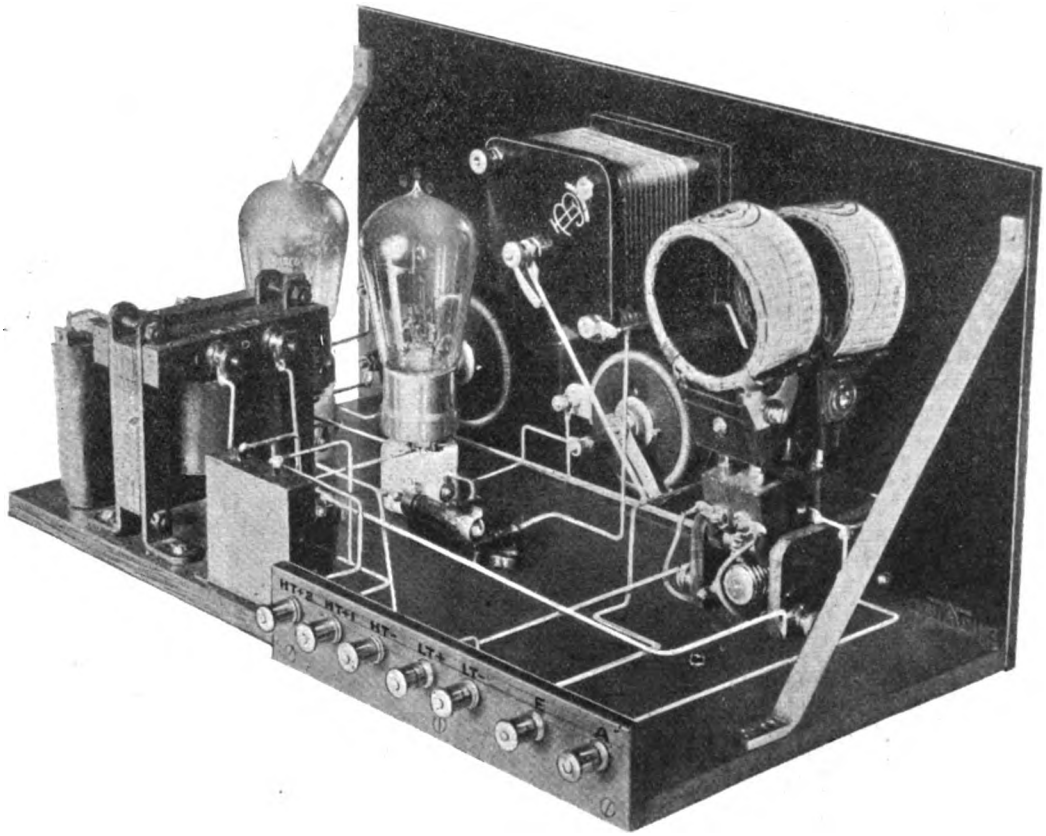
tinned copper, suitable lengths being stretched to straighten them before the bends are made, and the wires can then be fitted to their respective connections. It is always convenient to use terminal tags wherever possible, and to solder the wires to these. This simplifies the soldering, and gives a much neater appearance than is obtained by soldering the wires direct to the terminals. In addition, if at any time it is desired to dissemble the receiver, this can be done without finding that terminals and other pieces of apparatus are spoilt by the adhesion of solder. It will be seen that no switch has been provided to enable the variable condenser to be placed in parallel or series with the aerial coil, and in this receiver the variable condenser is permanently in parallel. This has been done partly for the sake of simplicity and partly because, when one considers that in changing over from the parallel to series position or *vice versa*, a gap will occur in the wavelength range if the same coils are left in, there is not much to be gained by arranging to switch from the parallel to series position unless compensating fixed condensers are to be provided as described recently in this journal. Such an arrangement would add somewhat to the complication, and it is always possible to interchange the coils so as to cover additional wavelengths as required.



A view of the interior of the set. On the right are the aerial and reaction coils; in the centre, the aerial tuning condenser, and on the left the H.T. battery condenser, transformer and grid battery. The grid condenser and leak are to the right of the first valve holder.

It is preferable to fit a 0·001 μF condenser across the terminals for the telephones, but this is not absolutely necessary, and has not been shown in the set.

This receiver is primarily intended for reception on the broadcast wavelengths and upwards by the employment of different coils, but those who desire to receive on the

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short wavelengths can do so also by a slight addition to the arrangement shown. This will be described here in case the constructor may care to adopt the method.

A flat slab coil wound on a card should be obtained, having, say, 15 turns of insulated wire of a gauge not less than No. 22. One end of the coil is connected to the aerial, instead of connecting the aerial to the terminal provided on the set, and the other end of the flat slab coil is connected to the common earth terminal The slab coil can be coupled to the tuned coil of the receiver by slipping it between the panel and the plug-in coil of the receiver.

By varying its position the amount of coupling can also be varied, and it will be found that using short wave coils of plug-in type, it is easy to tune down to very short wavelengths.

Before concluding, it is desired to point out that the circuit is one which will energise the aerial and cause interference easily if the reaction coil is brought near to the aerial coil. Care should be taken to see that when receiving broadcasting, the reaction coil should be far away from the aerial coil and this precaution will also result in clearer reception of the transmissions.

No particulars are included of the construction of a cabinet to house the set. In preparing such a box the principal point which should be borne in mind is that the top should be hinged to provide access to the valves and for the purpose of changing coils.

THE BALKITE BATTERY CHARGER.

The Balkite Battery Charger is an appliance for charging accumulators from ordinary electric light alternating current (200-240 volts, 50-60 cycles). It consists of a small transformer and a special rectifying cell. The cell has three electrodes, giving full wave rectification. Such a cell converts both half-cycles of the alternating current into direct current for charging the accumulator. One of the electrodes is of lead, and the others of a material referred to as Balkite. We believe, however, that Balkite is the trade name for a preparation of tantalum. An electrolyte of sulphuric acid is employed, and a small quantity of oil is added to the cell to prevent creeping and reduce evaporation.

The complete battery charger.

The charger is therefore a simple, straightforward arrangement, with no parts likely to get out of order or wear out. It delivers a taper charge commencing at the rate of 2½-3 amperes, and cannot discharge, short-circuit, or damage a battery by over-charging. The charging rate being 2½-3 amperes, a 6 volt 50 ampere hour accumulator will be completely charged in about 20 hours at an average cost of ½d. an hour, based on a cost of 6d. per unit.

An adaptor is provided for plugging into any electric light socket, and two spring clips for connection to the battery. This appliance is marketed by Messrs. Burndept, Ltd.

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THE EMISSION FROM A VALVE FILAMENT.

The author describes an interesting experiment, and shows that, probably due to the contact difference of potential, the plate current is not symmetrical with regard to the centre of the filament.

By G. S. P. HEYWOOD.

SUPPOSE that in a two-electrode valve, Fig. 1, the fall of potential across the filament is 2 volts. If the plate is now given a potential of $+\frac{1}{2}$ volts relative to the negative end of the filament, only the first quarter of the length of the filament is at a lower potential than the plate. Electrons can only flow therefore from this portion of the filament (neglecting for the present such disturbing factors as velocity of emission, space charge, etc.). So by measuring the current from the plate for different values of the plate potential from 0 to +2 volts, the current from successive fractions of the length of the filament may be determined.

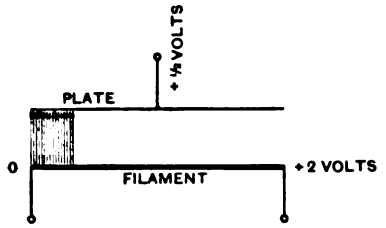

Fig. 1.

The two-electrode valve is connected as shown in Fig. 2. V is a voltmeter reading up to 8 volts; G is a micro-ammeter. Across the filament leads is connected a sliding potentiometer having 50 divisions, each of 20 ohms resistance. By this means the plate can be set at the potential of any given point on the filament, and the position of this point may be read directly off the potentiometer scale. The voltage across the filament is kept constant, and the micro-ammeter is read for various settings of the potentiometer slider. These readings give the currents from successive fractions of the length of the filament. By subtracting a given reading from the next one, the current from any part of the filament is

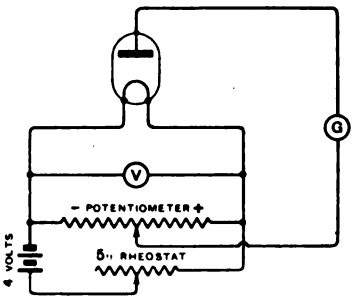

Fig. 2. Arrangement of apparatus for finding the plate current from different parts of a filament.

obtained. In order to verify the results, the connections of the filament are then reversed, and a fresh set of readings taken.

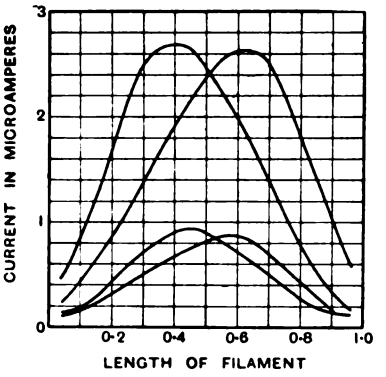

Fig. 3. The plate current from different parts of a filament.

The results of Fig. 3 were obtained with a 4-volt Mullard valve, R.D.93. The grid was connected to the plate, so that the valve acted as a diode, and readings were taken

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for the currents from successive tenths of the filament. The upper two curves give the currents when the fall of potential across the filament was 2 volts, the lower two when it was 1·8 volts. The curves show that the emission rises to a well-defined maximum near the centre of the filament; this is to be expected, for the centre of the filament is hotter than the ends.

It is found that the maximum is always displaced a short distance from the centre of the filament; this displacement is towards the positive end of the filament, whichever way round the latter is connected. Since each pair of curves is approximately symmetrical about the central line, this displacement cannot be due to lack of uniformity in the filament. It is probably caused by the contact potential between the tungsten filament and the nickel plate. Suppose the filament is positive to the plate, with a contact P.D. of ½-volt; and let the fall of potential across the filament be 2 volts, say. Then it is evident that 1½ volts must be applied to the plate in order to draw electrons off half the filament. In the experiment, this would cause a displacement of the apparent maximum of the curve towards the positive end, Fig. 4. The amount of displacement gives an indication of the value of the contact potential. By reversing the filament connections and taking the mean of the two curves, the true currents from every part of the filament are obtained.

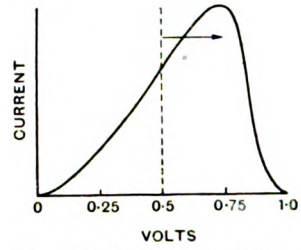
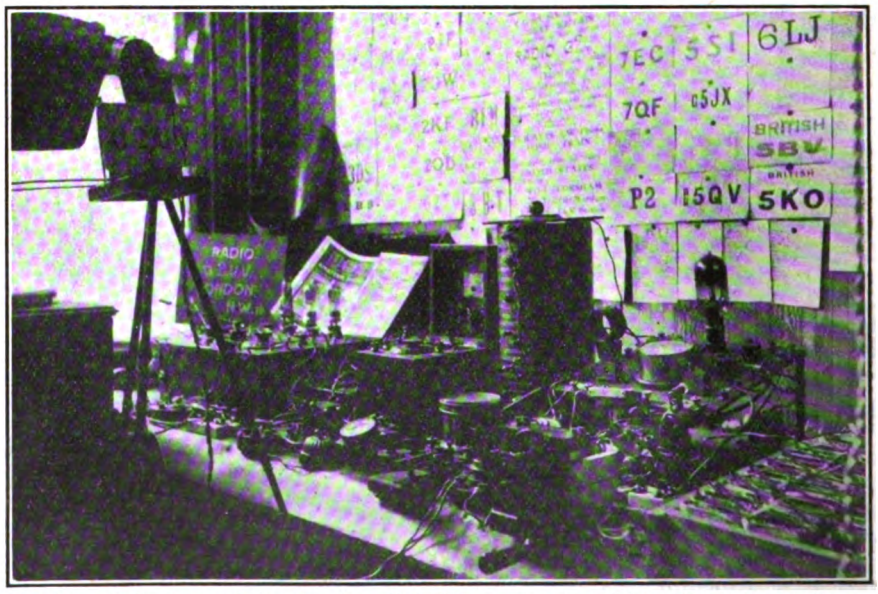


Fig. 4. The actual plate current from different parts of a filament.

This simple experiment not only gives us some information of the conditions inside a valve, but also seems to point the way to a more elaborate method of determining contact potentials. I am indebted to Mr. E. W. B. Gill, B.Sc. for the idea of the experiment.

A HAND GENERATOR STATION.



A view of the transmitting bench at G 2 U V, the property of Mr. W. E. F. Corsham. 2 U V may be numbered among the pioneers of British amateur transmitters; he secured the third prize in the first successful amateur Transatlantic Tests, and was the first Britisher to issue QSL cards. Mr. Corsham works principally with a hand generator, and many of his long distance records have been performed with dry cells

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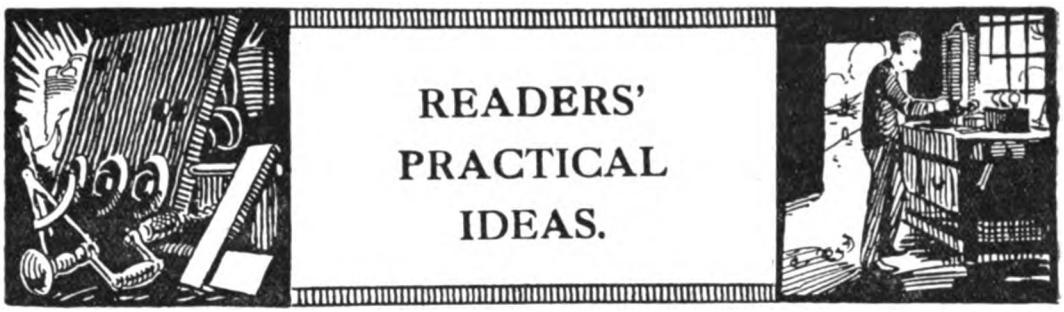
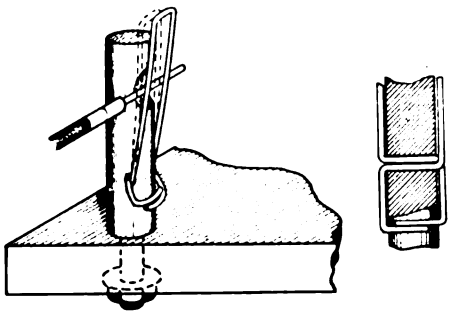


This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

An Easily Made Terminal.

OF simple construction, this terminal will be found to make a reliable contact. The construction can be seen quite clearly from the diagram. Hard springy brass



Spring terminal of easy construction.

wire should be used for making the loop pieces. Wires can be quickly inserted under the clip and a number of connections easily made to one terminal.

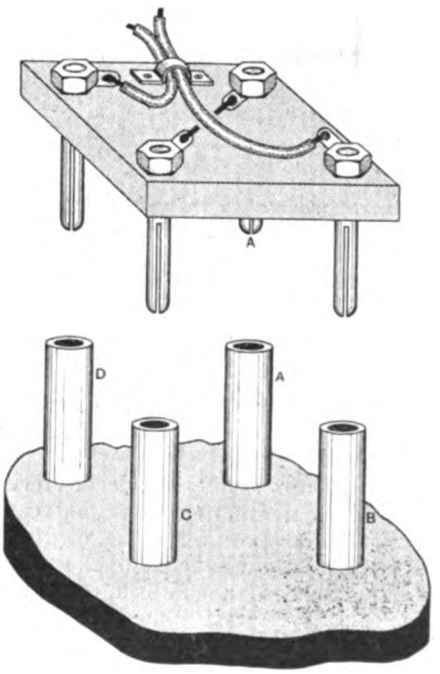
J. B.

Reaction Reversing and Short-circuiting Switch.

ALTHOUGH the reaction coil may be used with its leads permanently connected in circuit and no provision made for reversing the direction of reaction coupling, it will be found that the introduction of a change-over switch to reverse the connections to the reaction coil has many advantages.

A suitable switch is shown here, and is easily made up from four valve pins. A piece of $\frac{1}{4}$ in. ebonite measuring about $1\frac{1}{2}$ ins. by $1\frac{1}{2}$ ins., is squared up and tapped holes made at the corners. Into these holes the valve pins are inserted and lock nuts are fitted to hold the pins securely, and at the same time carry the tag connectors. These pins are made to engage into four valve sockets, A, B, C and D. The leads to the coil are connected either to A and C, or B and D, and it will be seen that by inserting the valve pins in the various sockets that the connections of the coil may be reversed or short circuited.

The addition of this simple switch to a receiving set will be found particularly useful at the present time when manufacturers of



Useful reaction reversing switch.

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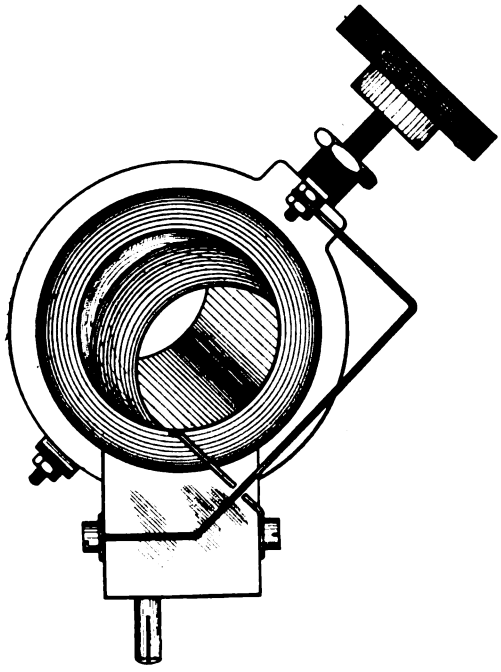
coils do not arrange the socket connections to produce a uniform direction of inductive coupling.

S. W. S.

A Plug-in Variometer.

THE anode plug-in coil is usually tuned by means of a parallel condenser, but there are many experimenters who still prefer to employ variometer tuning, particularly when working on the shorter wavelengths.



A variometer mounted on a plug-in socket has many useful applications.

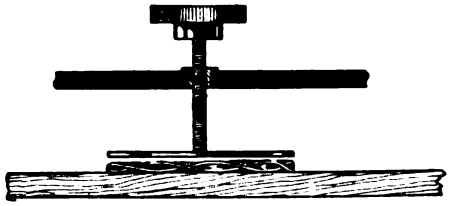
A set designed to use condenser tuning can be readily converted by mounting a variometer on the pin and socket of a coil holder. Only a few patterns of variometer are suitable and the accompanying drawing shows a simple method for mounting the Acme type.

A. T. C.

Spade Tuning.

THERE are many broadcast receivers in which the method of tuning consists of varying the position of a metal plate with regard to an inductance of the flat type. The inductance of a coil is altered as the position of the metal plate changes, thus providing the necessary tuning range.

A method of mounting the tuning plate is shown in the accompanying figure. Care must be taken to attach the disc quite squarely on the 2 B.A. spindle. The bush is tapped 2 B.A. and should fit tightly in the ebonite panel.



Coil tuned by the damping plate method.

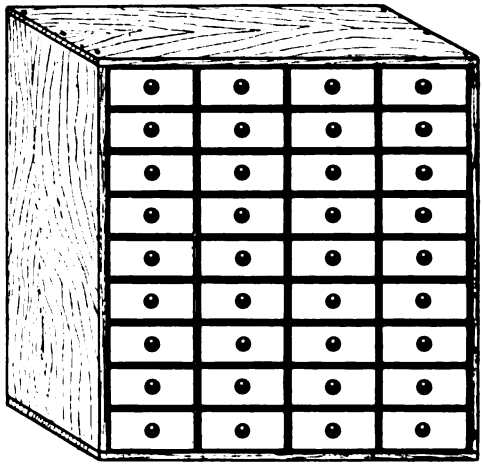
This method of tuning can be applied to both aerial and tuned anode circuits, and the greatest wavelength change will be produced as the disc makes contact with the face of the coil. The damping plate may measure about 3 ins. in diameter and can be constructed of brass or copper and soldered on to the end of the threaded rod.

H. D.

Cabinet for Screws, Washers, Nuts, etc.

ALTHOUGH somewhat crude in its construction, a cabinet made up as shown will prove exceedingly useful.

It consists merely of a number of match-boxes secured together by means of interleaving with cardboard and Seccotine, and



Cabinet for small screws, washers and nuts.

protected on the outside with pieces of thin mahogany or cigar-box wood. The knobs for withdrawing the boxes are brass paper fasteners.

A. W. R.

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SHORT WAVELENGTH RECEPTION.

The author tried three receivers and compared them by observing the strength of the signals received and the relative ease of adjustment. He concludes that the best receiver is the one having a regenerative valve detector with one stage of note magnification.

By E. J. MARTIN.

THE following experiences in reception on a wavelength of 220 metres and below may be of interest.

Receivers in general can be divided into three main groups: (1) reflex circuits; (2) circuits employing high frequency amplification. (3) circuits employing low frequency amplification. Experiments were made to determine which type was best suited for long distance short wave reception.

REFLEX CIRCUITS.

The efficiency of the valve as a high frequency amplifier is usually very much reduced when the valve is made to function as a low frequency as well as a high frequency amplifier. It was decided, therefore, to make good this loss in effectiveness by using one stage of ordinary high frequency amplification before the reflex stage. The circuit shown in Fig. 1 was employed.

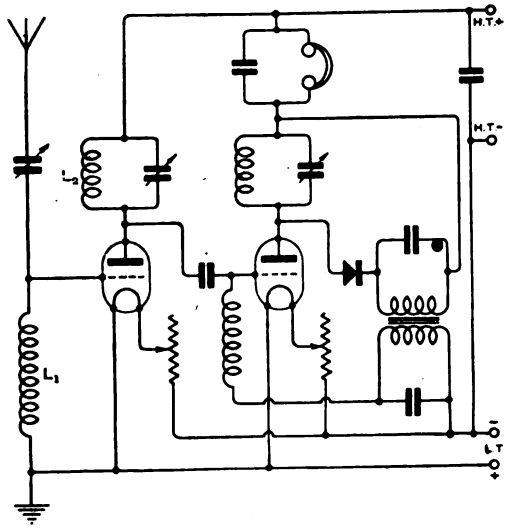

Fig. 1. A receiver with two stages of tuned high frequency amplification, crystal rectification, and one stage of speech frequency magnification.

Good results were obtained from broadcasting stations, but complications soon began to arise when it was used on the shorter wavelengths. When efficient inductances were used, the set oscillated continuously with no reaction coupling, in spite of special efforts to avoid capacity effects in wiring, etc. This difficulty was got over by employing reversed reaction between coils L_1 and L_2. This arrangement of the circuit was used when listening for American stations. Several stations were heard at good readable strength on 200 metres, but the set was not a practicable one for many reasons. It had too many controls, which made searching difficult, and its efficiency fell off as the wavelength was reduced.

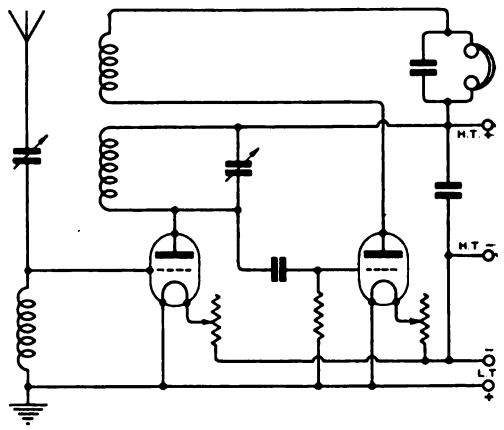

Fig. 2. A receiver giving one stage of high frequency amplification, with valve detector. The reaction coil is coupled to the anode coil.

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CIRCUITS EMPLOYING HIGH FREQUENCY AMPLIFICATION ONLY.

Bearing in mind the difficulties due to self-oscillation in the previous receiver, another receiver was wired, using one stage of high frequency amplification and valve detector, as in Fig. 2. This was a much more practicable circuit. Considerable magnetic reaction had to be used to make the set oscillate, provided that the aerial tuning condenser was not set at too small a value. The number of controls was reduced to three, which was better, but still rather too many. This did not give the same signal strength as when the circuit of Fig. 1 was employed. Only one or two American signals were faintly heard; also, although fairly good high frequency amplification was obtained on 200 metres, the amplification fell off for shorter wavelengths, until at about 120 metres the amplification was negligible. An ordinary "R" valve was used in the high frequency stage.

A CIRCUIT EMPLOYING LOW FREQUENCY AMPLIFICATION.

Finally, to reduce the number of controls to two, a valve detector and one note magnifier were employed, the detector valve being a peanut valve with 26 volts on the anode, as in Fig. 3. The reaction coil is coupled to the aerial coil, and if the circuit is handled carefully, no more interference will be caused by radiation than when the reaction coil is coupled to a circuit connected to the anode of a high frequency stage. This proved to be just the circuit required. Searching from 120 to 220 metres was an easy matter. Greater signal strength than that obtained from the circuit of Fig. 2 was obtained, with easier tuning. The degree of amplification was fairly constant, and did not fall off on the lower wavelengths. Many American stations were logged without difficulty.

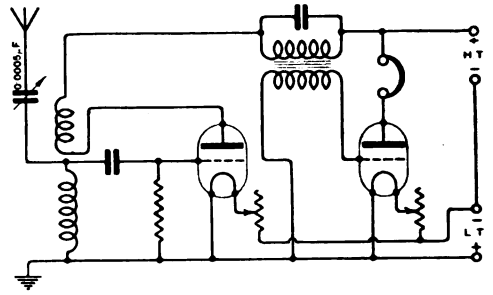

Fig. 3. This receiver has a valve detector and one stage of note magnification, with the reaction coil coupled to the aerial coil.

These experiences seem to show that the ordinary regenerative valve detector and note magnifier is the best simple set to employ. It may be found difficult to make the set oscillate on the lower wavelengths, but no difficulty should be experienced if the following points are borne in mind.

The aerial tuning inductance must be wound with a thick gauge of copper wire, such as No. 18 or 20, on a damp-proof former; preferably the wire itself should not be waxed or shellaced. If the coils are likely to get damp, enamelled wire may be employed. Preferably space the turns slightly. The reaction coil may be wound with fairly fine wire, on a former which is small compared to the diameter of the former employed in the construction of the aerial coil.

BROADCAST STAMP ALBUMS.

THE latest broadcasting craze in America centres round the radio stamp. A Chicago company gave the idea to the world.

The broadcast listener first sends for a copy of the stamp album. He receives it, together with a map, a broadcasting station call list and a batch of Proof of Reception cards. Space is provided on these for a list of broadcast items heard, the time of reception and other marks of proof. Having completed the particulars, the listener posts the card, together with a ten cent piece, to the station heard.

If the numbers and time tally with the station log the listener immediately receives a stamp bearing the station's call letters and design. This is pasted in the album and remains an eternal proof of the diligence, patience and skill of its owner.

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OBTAINING ANODE CURRENT FROM D.C. MAINS.

The H.T. supply for a valve receiver is usually obtained from a dry cell battery or a bank of low capacity accumulators. Both methods are expensive and troublesome. It is therefore of interest to learn that perfectly satisfactory results may be obtained at low cost from D.C. mains.

By G. G. BLAKE, M.I.E.E., A.Inst.P.

THE method usually employed to smooth out the hum from the D.C. supply is indicated in Fig. 1. L and L_1 are two 50-volt lamps in series across the mains (the positive is the live main, and negative earth). The lamps act as a potentiometer, and the H.T. supply to the wireless set *via* chokes I and I_1 can be varied by altering the relation between the resistances of the lamps. With this well-known arrangement, the ripple can be smoothed out until it is only heard as a very low hum, and when using a loud speaker and receiving strong telephony, this is not noticeable.

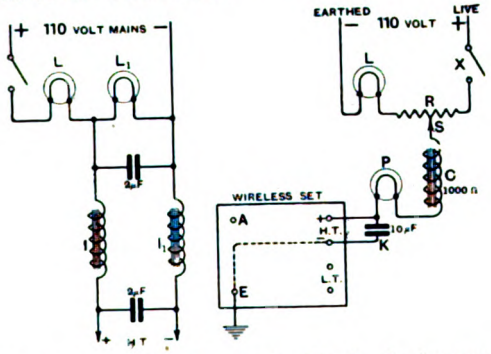

Fig. 1. A usual arrangement for obtaining smoothed H.T. from the mains for valve reception.

Fig. 2. An improved method.

When using headphones to receive distant stations, however, the writer found it impossible to entirely eliminate the hum in this way.

The best results were obtained when employing iron core chokes wound to a resistance of 1,000 ohms, and condensers of 10 microfarads capacity; but even then the hum was quite audible when no signals or telephony were being received. This form of H.T. supply was not comparable to the use of H.T. batteries.

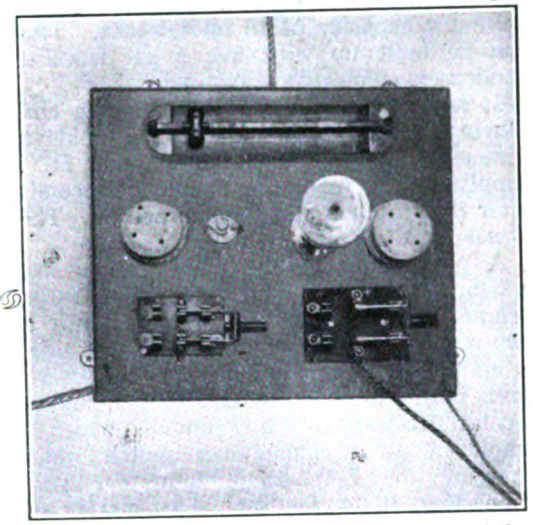

Fig. 3. The apparatus is easily constructed, and the components may be attached on a back board such as is used for mounting electrical fittings.

Fig. 2 shows the arrangement finally adopted by means of which the ripples are entirely eliminated and an absolutely silent H.T. supply obtained. L is a 110 volt 16 candle power carbon filament lamp in series with a resistance R (440 ohms) connected across the mains as shown, through a switch X. (A suitable resistance for this purpose is supplied by the Zenith Manufacturing Company.)

The H.T. is increased or decreased by moving slider S nearer to, or further from, the positive end of the resistance R. An iron-cored choke, C, wound to a resistance of about 1,000 ohms, is connected in series with the supply to smooth it. The secondary of a small motor ignition coil or even an intervalve transformer will answer the purpose. On its way to the positive terminal of the set, the current is passed through a small 4-volt lamp, the function of which

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is that of a fuse, and protects the wireless set in case of accident. Needless to say, as the maximum current which passes through this circuit is only 5 or 6 milliamperes, the lamp does not light up under normal working conditions. K is a condenser having a capacity of 10 microfarads. This can be built up with five 2 μF Dubilier condensers connected in parallel.

It is of interest to note, that when employing such a large capacity, it holds a sufficient charge to maintain the H.T. supply to the set for a couple of seconds after the switch X has been turned off. The signals gradually fade away.

A photograph of the apparatus in use appears as Fig. 3. The choke is mounted behind the board and in this instance a two-way switch, shown on the left-hand side, is employed to entirely insulate the board from both mains when not in use, and a second two-way switch is provided which is employed as a change-over switch when charging the L.T. accumulator or when connecting it to the set. The matter of accumulator charging is not dealt with in this article, so that no diagram of the connections to this switch need be given.

The same arrangement is found to work quite satisfactorily from a 220-volt main, on the 3-wire system; but in this case a 60-watt metal filament 220-volt lamp should be employed, and as both mains are live, a double pole switch must be used as shown in the photograph.

When the valves in the receiver require different anode voltages, the arrangement of Fig. 4 may be employed. The circuit shows two separate anode supplies obtained from two shunt circuits connected across the mains. Adjustable resistances R and R_1 and lamps L and L_1 are employed with smoothing chokes C and C_1 and condensers K and K_1. Several such circuits may be connected to meet the requirements of the receiver.

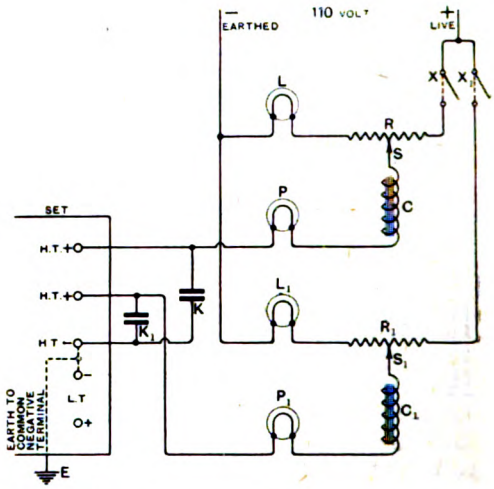
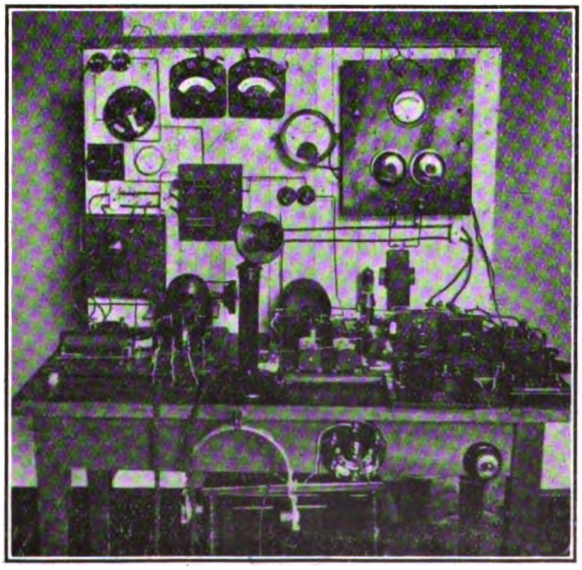


Fig. 4. Circuit arrangement for producing two values of H.T. potential.



STATION 5 CV.

In designing this station, the owner, Mr. Ronald J. Harrison, of Brondesbury, has aimed at neat and systematic arrangement of components to facilitate experimental work. Every component is easily accessible and the method of surface wiring allows for quick modification of circuits. The grid control transmitter is seen on the left of the table. The power valve and its panel are at the back, and to the front is the remainder of the grid circuit and tuning arrangements. With a plate potential of 240 volts, a current of 0·24 ampere is registered on the aerial ammeter when working on the shorter wavelengths. The microphone is of the standard Post Office type and gives very good results.

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A SIMPLE SHORT WAVE SET.

The author outlines the construction of a receiver which he has found very satisfactory for the reception of short wavelength signals.

By C. D. ABBOTT.

TO a great many amateurs the receiving of signals on 100 metres presents considerable difficulty. This is due to two main causes: (1) An unsuitable aerial-earth system, and (2) an unsuitable circuit.

(1) My experiments seem to show that the aerial should be as high as possible and consist of a single copper wire or strip about 50 feet long, and carefully insulated. Insulators of glass are satisfactory and I prefer them to the ordinary insulators of porcelain. The insulators should be of the long thin type which have a portion protected from the rain and thus have a long surface leakage path.

A counterpoise can with advantage be employed in place of the usual earth connection and may consist of about six wires placed eighteen inches or two feet apart and about six feet above the ground. The wires of the counterpoise should be carefully insulated, using as insulators, for instance, the ordinary egg or shell type. Arrange the counterpoise below the aerial, and of a length a little above that of the aerial.

(2) I have tried many circuits but find it difficult to make them oscillate at wavelengths of the order of 100 metres. Finally the circuit shown in Fig. 1 was adopted. It consists of a valve detector and one stage of low-frequency amplification, the reaction coil being connected to the anode of the detector and through a 0·0002 microfarad tuning condenser to the filament. A valve of the V.24 type is used as the detector, and an ordinary four-pin valve in the L.F. stage.

Special attention was given to the construction of the tuning coils. The coil in the aerial circuit consists of six turns of No. 12 bare copper wire with the turns spaced $\frac{1}{8}$ in. apart on a former consisting of four pieces of ebonite rod secured at the corners of two end pieces of wood or ebonite 4 ins. square. The secondary winding has fifteen turns and the winding is commenced two inches from the end of the primary winding. Both coils are put on in the same direction and are wound with No. 12 copper wire. For the reaction coil a winding of ten turns of No. 28 wire with the turns spaced $\frac{1}{8}$ in. on a former $3\frac{1}{2}$ ins. in diameter is fitted at the end of the secondary winding. This coil is not adjustable. The best position for it is found by experiment, and experience

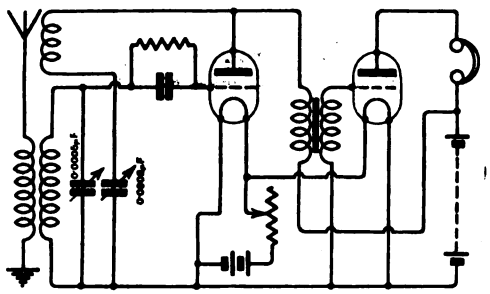

Fig. 1. The circuit of the receiver recommended for short wavelength reception.

shows that the desired smooth reaction effects may be obtained by adjusting the 0·0002 microfarad tuning condenser in series with it.

It is essential to employ good quality variable condensers, and as fine tuning is necessary for good results verniers should be fitted.

Special attention should be given to the wiring and the layout of the components. Allow ample room in order that the parts and wiring may be well spaced.

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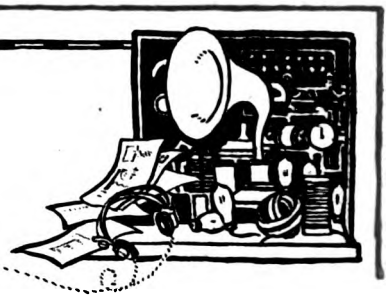
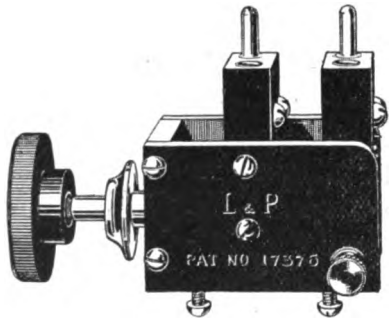
NEW APPLIANCES.



The L. & P. Two-Coil Holder.

The more usual patterns of coil holder suffer from the defect that they cannot be conveniently mounted behind the instrument panel and in consequence the coils project and either obscure apparatus on the front of the panel or occupy considerable panel space. This new coil holder is of the geared variety operating through a well-made worm and pinion.

The holder is not only designed for behind-the-panel mounting with a one-hole fixing, but can also be attached to the baseboard of the set or externally to the side or top of the cabinet. The metal parts are



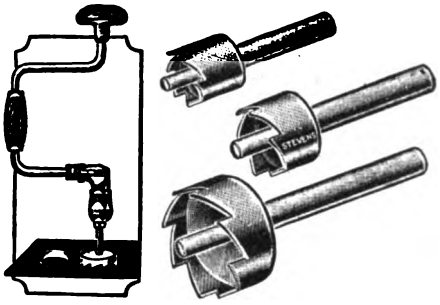
A geared two-coil holder which is suitable for mounting behind the panel.

nickel plated to conform with other recently introduced components, for there is a tendency at the present time to give all the component parts appearing on the instrument face a nickelled finish.

Panel Cutters.

Cutting large holes in ebonite panels is usually a laborious job for the amateur, as he does not possess a suitably large drill or the means for rotating it and usually has to resort to using his biggest drill and then filing out to the required size.

The panel cutters shown here provide an easy means for making holes of various sizes suitable for giving clearance to condenser spindles, etc., or large enough for

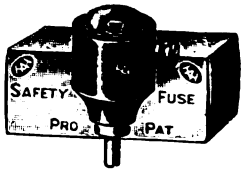


Cutters which may be employed for making holes in ebonite panels.

valve windows. These cutters are made in three sizes, ¾ in., 1 in. and 1½ ins., and are manufactured by Messrs. The Rockwood Co., Ltd.

A Wander Plug Safety Fuse.

A small fuse in the H.T. supply is always effective in protecting the battery from damage and at the same time preventing heavy currents being delivered such as if applied to valve filaments would immediately burn them out. The H.T. supply lead is the one part in a wireless receiver circuit where a fuse can be effectively employed, and if mounted on the wander plug will burn out should a short circuit occur anywhere in the instrument, as it is fitted at the actual point of distribution.



A fuse fitted to an H.T. wander plug.

This device is a product of Messrs. A. H. Hunt, Ltd., the well-known manufacturers of motor accessories.

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THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

The Selectivity of a Super-Heterodyne Receiver.

ALTHOUGH a super-heterodyne receiver usually has but two tuning controls—one for tuning the incoming signal and the second for adjusting the frequency of the oscillator—plus sometimes an adjustment for controlling the degree of regeneration, the selectivity is remarkable. The reasons for this extraordinary selectivity will be best understood by considering a practical example. Thus, let us suppose that we are receiving a signal having a wavelength of 300 metres and that the high frequency amplifier is adjusted to 3,000 metres.

Converting the values of wavelength to values of frequency, we find the corresponding frequencies are 1,000,000 and 100,000 cycles per second. Hence the oscillator is adjusted to a frequency of 1,100,000 cycles or 900,000 cycles—that is, 100,000 cycles above or below the frequency of the incoming signal.

Now imagine there is an interfering signal of 305 metres flowing in the tuner. This signal has a frequency of 983,600 cycles and will therefore set up a beat frequency of 116,400 cycles if the oscillator is set at 1,100,000 cycles or a beat frequency of 83,600 cycles when the oscillator is adjusted to 900,000 cycles. Converting the frequencies to wavelengths we find that while the 300 metre signal which we wish to amplify has a supersonic wavelength of 3,000 metres, the interfering signal of 305 metres has a supersonic wavelength of 2,580 or 3,590 metres, according to whether the oscillator is set at a wavelength below or above that of the incoming signal. Thus an interfering signal having a wavelength of only 5 metres greater than the desired signal produces a supersonic wavelength differing from 3,000 metres—the wavelength to which the high frequency amplifier is adjusted—by 420 or 590 metres respectively.

Under normal conditions, that is when a frame aerial is employed without reaction, a signal of 305 metres coming for instance from a station having a power about the same as that sending the signals desired and situated a similar distance away, would set up oscillations in the frame of relatively considerable magnitude, and would, of course, be heard with the desired signal. If somewhere in the high frequency amplifier portion of the super-heterodyne receiver, however, we provide a circuit which is sharply tuned to a given wavelength, say to 3,000 metres, as in the above example, the interfering signal which has a supersonic wavelength of 2,580 or 3,590 metres will not be amplified. A sharply tuned circuit, which is sometimes referred to as a filter, is always employed in the H.F. amplifier. Usually it is connected between the first detector and the first amplifying valve, but may almost equally well be connected between the last stage of the H.F. amplifier and the input circuit of the second detector. The filter may consist of a tuned transformer or a tuned anode coil employing carefully wound coils and condensers.

A Super-Heterodyne Receiver Having Three Stages of Resistance Coupled H.F. Amplification.

Perhaps the simplest super-heterodyne receiver is that which employs a resistance coupled H.F. amplifier. The circuit for such a receiver is given in Fig. 1 and is recommended to beginners. This is the circuit of the first super-heterodyne receiver which I built when studying the subject, and it gave very good results indeed when one considers the ease with which it is put together and the relative low cost of the components. We have first the frame aerial and tuning condenser C_1. For 250 to 550 metres the frame had 15 turns of No. 18 D.C.C. wire wound on a skeleton framework 15 inches square, and C_1 had a capacity of 0·0005 microfarads. Connected to the frame circuit on one side is the grid condenser and leak C_2, R_1, of

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0·00025 microfarad and 2 megohms respectively, and on the other side a coupling coil L_3 consisting of 15 turns of No. 22 D.C.C., 1½ ins. diameter. In the anode circuit of the first detector is the primary winding L_1 of a high frequency transformer shunted by a fixed condenser C_3 having a capacity of 0·001 microfarad. The transformer actually employed was an Igranic (size 4), which consists of two duolateral coils suitably placed together, with a four-pin plug. The three valves of the high frequency amplifier are resistance coupled, having anode resistances R_4 of the No. 22 D.C.C. Both were wound on a basket coil former 1½ ins. in diameter, with 15 spokes. These were tied together, and the coupling coil mounted near them in order that variable coupling could be obtained. Condenser C_8 of 0.0005 microfarad capacity tunes the grid circuit, and condenser C_9 of 1 microfarad completes the anode circuit for H.F. currents.

To tune-in a signal the frame aerial condenser is set at a value and the oscillator tuning condenser slowly turned. This process is repeated until a signal is heard and then

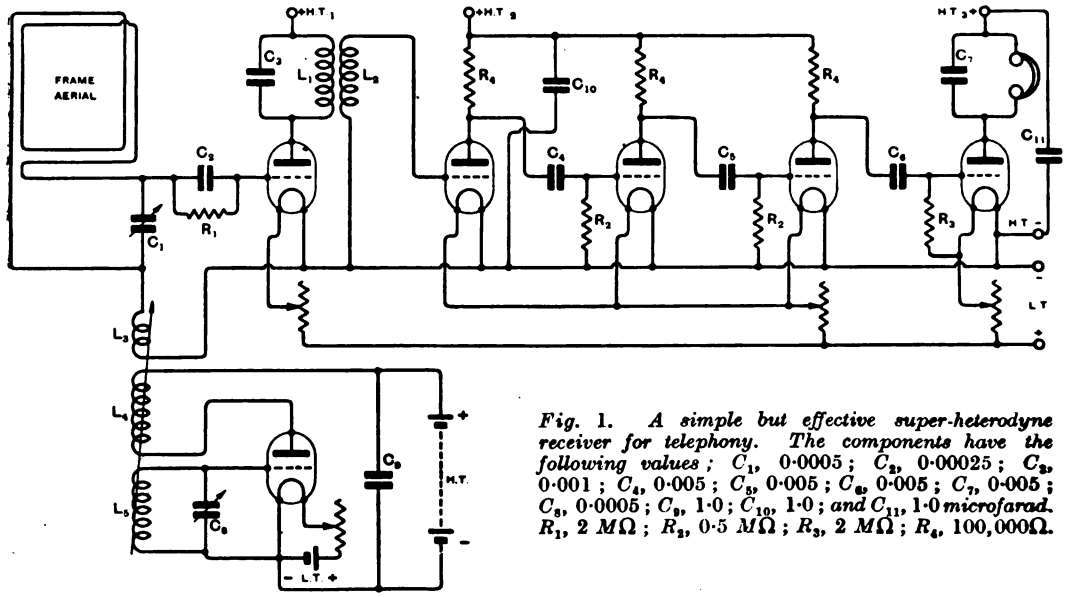

Fig. 1. A simple but effective super-heterodyne receiver for telephony. The components have the following values; C_1, 0·0005; C_2, 0·00025; C_3, 0·001; C_4, 0·005; C_5, 0·005; C_6, 0·005; C_7, 0·005; C_8, 0·0005; C_9, 1·0; C_{10}, 1·0; and C_{11}, 1·0 microfarad. R_1, 2 MΩ; R_2, 0·5 MΩ; R_3, 2 MΩ; R_4, 100,000Ω.

grid leak type, with a resistance of 100,000 ohms each, coupling condensers C_4, C_5 and C_6, and grid leaks R_2 and R_3. The coupling condensers had a value of 0.005 microfarad, the grid leaks R_2 a resistance of 0.5 megohm and R_3 a value of 2 megohms. It will be noticed that the grid leaks R_2 are connected to the negative side of the filaments, while R_3 is connected to the positive side for rectification.

A separate oscillator having its own filament and anode batteries was employed. The grid and anode coils were ordinary basket coils, the grid coil L_5 having 55 turns of No. 22 D.C.C. and the anode coil L_4 40 turns of both condensers are accurately set to the best values.

With this simple set no difficulty at all should be experienced in receiving many stations situated a long distance away. I heard many continental and several American stations with this elementary arrangement and learned many of the tricks of super-heterodyne receivers as well. At the moment I am testing a set which I have built after a good deal of experimenting which is altogether superior to the simple set mentioned above, and hope to describe its theory and design in an early issue of this journal.

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PATENTS AND ABSTRACTS.

A Reflex Receiver.

In ordinary reflex receivers it is usual to connect the frame aerial or the tuner direct to the first valve by connecting one side of the tuned circuit to the grid and the other side to the filament. The latter connection determines and fixes the average voltage of the grid and is set in accordance with the characteristic curve of the particular valve in use. It is claimed, however (British Patent No. 223,648) that better results may be obtained by connecting a fixed condenser of small capacity in the circuit, as in Fig. 1, to prevent the grid taking up the normal voltage of the filament. Referring to the figure we see that the frame aerial F, tuned by condenser C, has one of its ends connected to the grid and the other end joined to the fixed condenser C_1, and that the secondary winding of the L.F. transformer is connected between the filament and the other side of C_1. Incoming signals are therefore applied to the first valve and amplified, being passed to the valve detector by the H.F. transformer T_1. The rectified currents then pass through the primary winding P of the L.F. transformer, setting up voltages in the secondary winding S which influence the grid of the first valve. These L.F. voltages pass through the fixed condenser C_1 in the grid circuit; hence the capacity of this condenser must be such that it does not offer a high impedance to the L.F. voltages. According to the patent specification, a capacity of 0·005 microfarads is suitable—although, of course, it may be larger. As the grid is influenced by the L.F. voltages magnified L.F. currents flow in the anode circuit and actuate the telephones T.

With this circuit we therefore obtain one stage of H.F. amplification followed by valve detection and then one stage of L.F. magnification. The effect of condenser C_1 is to break the grid circuit to direct currents, and leaves the grid of the valve free to assume a voltage determined by the operating conditions. When the grid is made positive, a small grid current flows and charges the condenser C_1, giving the grid a slight negative potential. Consequently the average working potential of the grid is automatically adjusted to that degree of negative potential which just prevents self-oscillation of the valve. With this potential on the grid the valve is in its most sensitive and responsive

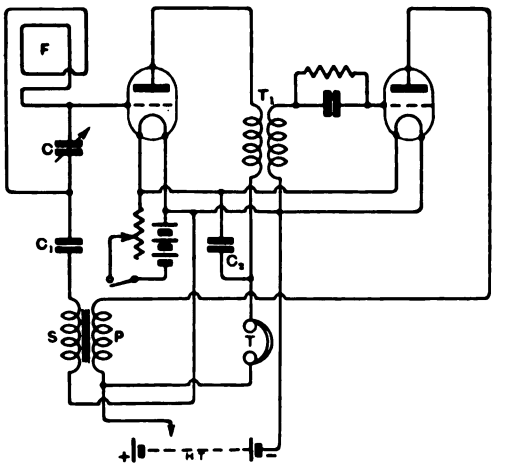

Fig. 1. A reflex receiver giving one stage of H.F. amplification, valve detection, and one stage of L.F. magnification.

condition. The explanation of the action and the theory of condenser C_1 in circuits of this type is complex, but it is said that in practice a considerable increase in the signal strength is obtained by including this condenser in the circuit.

The values of the components employed in this circuit are usual ones, and depend on the wavelength of the signals to be received. For instance, the tuning condenser C may have a capacity of 0·0005 microfarads, C_2, 0·002 microfarads and the grid condenser and leak 0·0003 microfarads and 2 megohms respectively. The H.F. transformer T_1 may comprise two basket coils tuned with a 0·0002 microfarad condenser, or a pin-type transformer may be employed. If the windings are of fine wire having a fairly high resistance, there is no need to tune the transformer with a variable condenser.

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NOTES & NEWS

Additions to the Marconi station at Carnarvon have facilitated the opening of a second direct wireless telegraph service between London and New York.

* * * *

The Admiralty have closed the wireless station at Goswick, Berwick. It was built during the war, and has been used as a direction-finding station for naval and navigation purposes.

* * * *

For the benefit of the American Colony in Paris, a special "American Night" was held at the *Petit Parisien* broadcasting station on January 12th.

* * * *

A broadcast receiver has been installed in the reading room of the House of Parliament in Vienna for the benefit of members.

* * * *

BRIGHTER PROSPECTS FOR DUTCH TRANSMITTERS.

Signs are not wanting that the heavy restrictions upon amateur transmitters in Holland are being relaxed by the authorities. According to an English correspondent now in Utrecht, ten amateur transmitting stations have now been licensed, with the call signs PB 1 to PB 10, and good DX work is being carried on with America.

WIRELESS AND SOLAR ECLIPSE.

Special arrangements have been made in America to observe whether the solar eclipse of January 24th will influence the transmission and reception of wireless signals. Although the eclipse will be partial as viewed from this country, it will be total over a belt covering Western New York, Connecticut, Northern Pennsylvania, and New Jersey. On previous occasions American listeners have noticed an improvement in signals during the progress of an eclipse.

SHORT WAVE RECEPTION IN SHEFFIELD.

With reference to the newly-opened service between Nauen and Buenos Aires on 30 metres, a Sheffield reader, Mr. Lawrence Manning, reports regular reception of these signals on a two-valve (0—v—1) receiver. The call sign used by the German station is apparently POX, not POZ, and has probably been allocated for this special service.

WIRELESS SERVICE AT SEA.

Sir Bertram Hayes, upon his retirement from the command of the "Majestic," received a congratulatory wireless message from the Chatham Multiplex Marine Station, Massachusetts, recalling that his ship holds the world's high-speed record in radio transmission for working at 150 words per minute.

In reply to this message Sir Bertram Hayes expressed his gratitude to the wireless stations for their kind assistance in establishing the position of the ship when required. He added that the "Majestic's" high-speed record is due to the extraordinary efficiency of the Marconi operators.

BELGIAN AMATEURS BUSY.

Further Belgian successes in transatlantic amateur working are reported.

On December 28th, B 4 RS communicated at 6.20 a.m. with U 1 KC, of Northampton, Mass., with a plate input of 20 watts. The transmitter employed was illustrated in our issue of December 3rd last.

Belgian 4 QS, on the morning of December 6th, was successful in working with two U.S. amateurs, viz., 1 SF and 3 AB. 4 QS used less than 20 watts.

WIRELESS PHOTOGRAPHS ON VIEW.

In view of the recent successful experiments in the wireless transmission of photographs between New York and London, special interest attaches to the latest exhibit at the Science Museum, South Kensington. The exhibit shows a photographic film of the Prince of Wales which was actually used for the purpose of transmission, a photograph of the portrait as received in New York, and a copy of one of the American newspapers in which it appeared. The exhibit is to be found in the Western Hall at the Science Museum, Imperial Institute Road.

GOOD WORK WITH A SUPER-HETERODYNE.

A more than usually interesting log of the reception of American broadcasting stations has been forwarded by Mr. E. A. Devine, of Wooler, Northumberland, who, in less than four hours on the night of December 27-28th, listened to eight American transmissions. At 12.15 a.m. children's stories were heard at WBZ, and following the closing down of this station, WHAR was logged through serious morse jamming. Strong band items were received from KDKA at 1.30, and half an hour later the Montreal station was heard with great clearness. PWX, of the Cuban Telephone Co., Havana, was next tuned in and solos and announcements in Spanish were heard at comfortable strength. WOR and WGY were then picked up in succession.

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and finally, at 3.45, WIP, of Philadelphia, Pa., was heard clearly and strongly on telephones.

These very satisfactory results were obtained on a seven-valve super-heterodyne receiver. The night in question appears to have been extremely favourable for long distance reception, as we have received interesting reports from a number of listeners.

MORE ABOUT WGH.

Apropos our recent note on the identity of WGH, we are indebted to Mr. A. N. C. Horne, of Queenstown, Ireland, for supplying official information which revises the details already given.

The following particulars are taken from the International List of Radio Telegraph Stations. The name of the station is Tuckerton, New Jersey, WGH, and its normal range is given as 4,000 nautical miles. A General Electric valve transmitter is employed and work is carried out on wavelengths of 90, 93, 97, 100 and 103 metres.

I.E.E. ANNUAL DINNER.

The Annual Dinner and Reunion of the Institution of Electrical Engineers will be held at the Hotel Cecil, Strand, W.C., on Thursday, February 12th, under the Presidency of Mr. W. B. Woodhouse, supported by the Council. Tickets should be applied for as early as possible, and application forms may be obtained from Mr. P. F. Rowell, Secretary, at the Institution, Savoy Place, W.C.2.

MORE DX WITH MOSUL.

"We had no difficulty in working with each other," states Mr. R. L. Royle (2 WJ), of Palmers Green, London, in a report of successful DX with GHH 1 (Mosul) on December 29th. The communication took place on 90 metres between 3.20 and 4.20 a.m. (G.M.T.) and signals from Mosul were of excellent strength. The power input at 2 WJ was 130 watts, and at Mosul, 100 watts.

NEW WIRELESS EXPORT JOURNAL.

The Wireless Export Trader, published by The Trader Publishing Co., Ltd., 139-140 Fleet Street, London, E.C.4, is a new monthly journal designed to keep overseas importers and dealers in touch with the development of Radio Industry in Great Britain, and also supplies of British goods for resale in all the world's markets.

The publishers, who have had experience in the production of trade journals extending over 30 years, are confident that this journal will meet a real need. The world demand is all for reliable productions of up-to-date design, and the British industry is doing more than any other to supply this, and is keeping well in the forefront of radio research and progress.

The worldwide subscription rate is 10s. per annum, post free.

An imposing display of amateur apparatus was a feature of a Wireless Exhibition recently held under the auspices of the Maidstone and District Radio Society. Our photograph shows a portion of the exhibition.

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ATMOSPHERICS OVERCOME?

Bold claims are made for a new invention, by a young Frenchman named Verdan, designed to overcome atmospheric and other interruptions in the transmission of wireless telegraph messages. According to reports the apparatus transmits messages by a system of printed letters. Practical experiments are soon to be made with the new appliance between Nice and Ajaccio, Corsica, and it is hoped that, as a result, the cable between France and that island may be dispensed with.

BEAM WIRELESS IN CANADA.

A group of new stations is being erected near Montreal by Marconi's Wireless Telegraph Company of Canada for direct communication with England and Australia by means of the beam system.

Each station is to be capable of communication at a speed of 105 letters per minute each way during a daily average of 18 hours.

APPLAUSE-O-GRAM
RCA
From a member of your unseen audience comes the word of enthusiastic appreciation for your fine program at Station 2 LO on Nov 28 '24
Newman Grove Nebr

Two typical applause cards at present in vogue in America.

BOOKS RECEIVED.

Some Methods of Testing Radio Receiving Sets. By J. L. Preston and L. C. F. Horle (Washington: Department of Commerce, Bureau of Standards. Price, 10 cents.)

Chronicle Wireless Guide for the Amateur Constructor. (Manchester: Allied Newspapers, Ltd., Withy Grove. Illustrated with Circuit and Wiring Diagrams and Photographs. Pp. 104. Price, 6d. net).

TRADE NOTES.

Messrs. Radio Instruments, Ltd., inform us that Mr. A. J. B. Harris, until recently testing officer in charge of wireless receiving instruments and valves at the Signal School, Royal Naval Barracks, Portsmouth, has joined the technical staff of the company as superintendent of their test room.

* * * *

A move to larger and more commodious premises has been made by Messrs. The Dubilier Condenser Co. (1921), Ltd., the company's new address being Ducon Works, Victoria Road, North Acton, London, W.3.

RADIOTELEPHONY AND AFRICAN FLIGHT.

Wireless telephony is playing a considerable part in the flight from Paris to Lake Chad, which the French aviators—D'Oisy, Goys, Vuillemin and Dagneau—began on January 16th. During the flight the airmen have been in constant touch with the wireless stations at Le Bourget, Marseilles and Toulouse. The principal wireless telephony stations at Algiers, Dijon, Lyons and Perpignan, are also maintaining a listening watch. This aerial voyage in Africa, which is attracting considerable attention in France, will cover a distance of 4,293 miles on the outward journey alone.

CORRESPONDENCE.

A.C. on the Short Wavelengths.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I wish to draw your attention to the rapid increase in the use of unrectified, or very badly rectified A.C. telegraphy on the shorter wavelengths.

During the recent month or so many British stations and a far greater number of Continental experimenters have reduced their wavelengths to somewhere between 60 and 100 metres. It is well known that experimental stations in the Antipodes and those in the American Continent work for the most part on waves between 70 and 90 metres, which range is badly crowded at the present time.

The introduction of this badly tuned type of A.C. signal to the most interesting of all wave bands is causing considerable interference to long distance communication; for example, Australian 3 BQ is invariably blotted out on Sunday evenings (which is the only time the English amateur may hope to effect contact) by some inconsiderate experimenter using a signal spreading over some 5 metres or more, thus effectively and completely spoiling every chance of copying the usually feeble Australian signal.

I am certain that I am voicing the opinion of most amateurs of long standing in lodging this complaint against the unrectified signal expert.

The position is steadily becoming worse each week and the obvious way to clear the trouble is to urge, wherever possible, all European amateurs to refrain from transmitting below 90 metres during the very brief periods the A and Z stations are audible on this side.

Many experimenters are under the impression that to transmit between 60 and 85 metres is a sure way to successful working with the U.S.A., and it is with this object in view that they have decreased their wavelengths. I would like to point out that the hope of being received in America between 65 and 85 metres is a very small one indeed owing to the terrific QRM at all times.

The U.S.A., Australian and New Zealand enthusiasts are listening for European amateurs around 100 metres, and occasionally on 50 metres, but never between 65 and 90.

I shall be glad if you will be good enough to publish this letter at your earliest convenience.

J. A. PARTRIDGE, G 2 KF.

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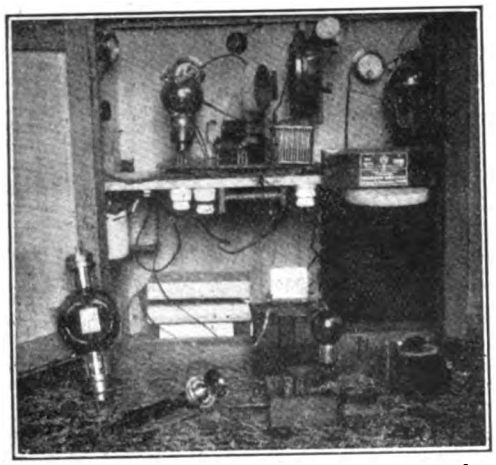
Calls Heard

St. Helier, Jersey.
British: 2 AS, 2 AV, 2 CC, 2 DR, 2 FN, 2 FQ, 2 FU, 2 GY, 2 IL, 2 KW, 2NM, 2 RB, 2 RX, 2 TR, 2 ZN, 2 CC, 5 CX, 5 GS, 5 HA, 5 IG, 5 IK, 5 LH, 5 LS, 5 MO, 5 MT, 5 OX, 5 RZ, 5 SU, 5 TZ, 5 UL, 5 UO, 6 AH, 6 AL, 6 FA, 6 GH, 6 GM, 6 KK, 6 LJ, 6 LO, 6 WI, 6 ME, 6 NF, 6 QB, 6 TD, 6 US. French: 8 AB, 8 BO, 8 BP, 8 BRG, 8 CH, 8 CT, 8 DY, 8 EM, 8 EP, 8 EU, 8 EV, 8 FV, 8 GI, 8 GK, 8 GO, 8 HSF, 8 HSM, 8 IF, 8 II, 8 KC, 8 KK, 8 LPR, 8 JBL, 8 PA, 8 PP, 8 RBR, 8 RG, 8 RGT, 8 SG, 8 SR, 8 SSC, 8 SSU, 8 SSV, 8 UD, 8 WK, 8 WZ, 8 XR, 8 ZM, 8 ZZ, 8 ZZX. Dutch: 0 AX, 0 BQ, 0 GC, 0 MS, 0 RE. Danish: 7 EC, 7 ZM. Italian: 1 AM, 1 MT, 3 RM. Luxembourg: 0 AA. Swedish: SMZN, SMZV, SMZY. Belgian: 4 ALS, 4 C 2, 4 QS, 4 SS, 4 YZ, B 7, IO 2. Swiss: 9 AA, 9 AD, 9 BR. Finland: 2 NCA, 2 NM, 3 NB. Canadian: 4 KU. New Zealand: 2 AC. Argentine: CB 8. Mexican: 1 B. U.S.A.: 1 AJA, 1 ARJ, 1 AVR, 1 BIE, 1 BSD, 1 CKJ, 1 CMP, 1 DHT, 1 IEF, 1 JBL, 1 KC, 1 ML, 1 OW, 1 PL, 1 SW, 1 XC, 1 XP, 1 XW, 2 ABO, 2 ANA, 2 BCO, 2 BCW, 2 BGG, 2 BRC, 2 BF, 2 CTY, 2 CVU, 2 CH, 2 CY, 2 EQ, 2 KU, 2 MC, 3 BCK, 3 ADB, 3 BGP, 3 BTU, 3 BU, 3 BWP, 3 CBL, 3 CH, 3 CHC, 3 CHG, 3 CKJ, 3 GC, 3 QV, 3 SD, 3 VW, 3 ZW, 4 AU, 4 KU, 4 RR, 4 TJ, 4 UA, 4 XE, 5 CPM, 5 HL, 5 RU, 5 SN, 6 BUR, 6 CSR, 7 AKK, 8 AVL, 8 AP, 8 ADD, 8 ADG, 8 BF, 8 CC, 8 CE, 8 CKO, 8 SP, 8 KC, 8 ZG, 9 CA, NFV, NKF. Various: AGN, AIN, IHU, OCDJ, POZ, WGH, 1 OKZ, YA 79. (o—v—1.) (D. Grove-White, 2 AWO.)

Wandsworth Common, S.W.17. (60 to 200 metres).
Telephony: 2 FM, 2 KF, 2 JU, 2 PY, 2 SX, 2 TI, 2 TK, 2 UC, 5 BT, 5 DT, 5 IO, 5 IS, 5 KS, 5 LP, 6 BBC, 6 RM. Dutch (Telegraphy): OAB, OAZ, OGC, ONI, ONN, ORE. Finnish: 2 NM. British: 2 AWO, 2 BSC, 2 CC, 2 CV, 2 DR, 2 DX, 2 FM, 2 FU, 2 IT, 2 KF, 2 LZ, 2 MK, 2 NB, 2 NM, 2 NY, 2 OD, 2 PY, 2 RQ, 2 TA, 2 TF, 2 TQ, 2 WJ, 2 WP, 5 AM, 5 AR, 5 BH, 5 CB, 5 CC, 5 CX, 5 HA, 5 IM, 5 LU, 5 MO, 5 OX, 5 PD, 5 RH, 5 RZ, 5 TZ, 5 UQ, 5 WI, 6 AL, 6 AN, 6 FG, 6 FQ, 6 GD, 6 GH, 6 GM, 6 ME, (? working 6 GM), 6 NF, 6 QA, 6 TM, 6 WO, 6 YB. Danish: 7 EC. French: 8 AB, 8 AP, 8 BV, 8 CA, 8 CU, 8 DM, 8 DU, 8 EN, 8 EU, 8 FI, 8 FK, 8 FQ, 8 FR, 8 FU, 8 GI, 8 GK, 8 GO, 8 HS, 8 HSM, 8 II, 8 LL, 8 LP, 8 UD, 8 UU, 8 WAL, 8 ZZ. Swiss: 9 BR. Belgian: 4 AL, 4 SS, 4 YS, 4 YZ, Q 1. American: 4 EQ, 4 IO, 8 CCR. Various: UG 5, WGH, ABC. (o—v—1)
(F. R. Wells and C. E. P. Jones, 2 CA.)



Some of the apparatus at 8 AP, the French telephony transmitter. 8 AP employs a power of 100 watts.

Worksop.
British: 2 BF, 2 CC, 2 DD, 2 DX, 2 EX, 2 FN, 2 FU, 2 GM, 2 JF, 2 JK, 2 KW, 2 MX, 2 NB, 2 NF, 2 NM, 2 OD, 2 RB, 2 SH, 2 SZ, 2 TF, 2 UD, 2 UJ, 2 UX, 2 XI, 5 BS, 5 BV, 5 CC, 5 CX, 5 DA, 5 DN, 5 IK, 5 KQ, 5 KZ, 5 MA, 5 MO, 5 MX, 5 NN, 5 OX, 5 RQ, 5 RZ, 5 SK, 5 SU, 5 UQ, 5 WG, 5 XN, 6 AL, 6 GH, 6 GM, 6 GS, 6 JL, 6 KK, 6 LJ, 6 NF, 6 NN, 6 NL, 6 QB, 6 TD, 6 TM, 6 RY, 6 XJ. Belgian: 4 AU, 4 CA, 4 CZ, 4 CL, 4 GP, 4 II, 4 QL, 4 QO, 4 QS, 4 QY, 4 QZ, 4 UF, 4 UU, B4 YZ, P1, P 2, W 2, B 5. Dutch: OAL, 0 BA, 0 BQ, 0 DA, 0 GA, 0 GG, 0 GK, 0 GL, 0 HM, 0 II, 0 ML, 0 MS, 0 NN, 0 OD, 0 PG, 0 QW, 0 RE, 0 RF, 0 RM, 0 RW, 0 SK. 0 ZZ. Finnish: INA, FN 2NM, FN2NCA. Danish: 7 EC, 7 MP, 7 QM, 7 ZM, 7 GQ? Rhineland: 3 CA, 1 CF, 8 SSU. Italian: 1 ER, I MT, I NN, I HT. Swedish: SM YM, SMYY. American: 1 BGQ, 8 BQ, 2 NG, 2 CB, 2 BUD, 2 XR, 3 OT, 3 HG. Various: 9 AD, 9 BU, 9 PA, POZ, ACX, ICS, IST, WGH, IOKZ, 1 KH, 1 YS, ICCM de 2 YT, NSF, 14 J. French: 8 AB, 8 AD, 8 AI, 8 AL, 8 AQ, 8 ARA, 8 AS, 8 AU, 8 BA, 8 BF, 8 BN, 8 BP, 8 BR, 8 BU, 8 BV, 8 BZ, 8 CA, 8 CK, 8 CM, 8 CN, 8 CT, 8 CZ, 8 DA, 8 DB, 8 DD, 8 DI, 8 DM, 8 DN, 8 DO, 8 DP, 8 DU, 8 ÉE, 8 EK, 8 ÉM, 8 EO, 8 EU, 8 ÉV, 8 FC, 8 FI, 8 FK, 8 FM, 8 FP, 8 FR, 8 FU, 8 GF, 8 GG, 8 GH, 8 GK, 8 GL, 8 GM, 8 GO, 8 GP, 8 GS, 8 GU, 8 HSD, 8 HSF, 8 HSM, 8 IG, 8 IP, 8 JH, 8 JHK, 8 JHL, 8 JM, 8 JU, 8 LA, 8 LI, 8 LM, 8 LP, 8 LPK, 8 LR, 8 MA, 8 MAR, 8 MK, 8 MN, 8 MU, 8 MZ, 8 NB, 8 NE, 8 NS, 8 OK, 8 PA, 8 PD, 8 PHO, 8 PP, 8 PS, 8 PU, 8 QD, 8 QG, 8 QM, 8 QR, 8 QT, 8 QU, 8 RG, 8 SBN, 8 SD, 8 SK, 8 SM, 8 SSC, 8 SU, 8 UA, 8 UD, 8 UF, 8 UK, 8 UU, 8 UZ, 8 VV, 8 WK, 8 WV, 8 WZ, 8 XH, 8 XM, 8 XR, 8 XS, 8 XX, 8 XZ, 8 YA, 8 ZM, 8 ZP, 8 ZU, 8 ZUT, 8 ZZ. (o—v—o)
(No aerial or earth used.) (E. R. Martin.)

Northampton.
Telephony: 2 YR, 5 FZ, 5 OD, 5 KW, 8 FC. British (Morse): 2 AV, 2 AWO, 2 BN, 2 LQ, 2 FN, 2 GN, 2 JF, 2 JU, 2 KT, 2 KW, 2 LZ, 2 NB, 2 SH, 2 TU, 2 VJ, 2 WJ, 2 WY, 2 XY, 2 YT, 5 GS, 5 HA, 5 LF, 5 LS, 6 AH, 6 FA, 6 LJ, 6 ME, 6 QB, 6 UV, 6 XG, 6 YF. American: 1 AE, 1 AEA, 1 AJG, 1 ANR, 1 ARE, 1 BDT, 1 BHM, 1 BOA, 1 CKP, 1 DA, C1 DQ, 1 ER, 1 XAV, 1 XZ, 1 ZAB, 2 AAY, 2 AFP, 2 AG, 2 AWF, 2 AZY, 2 BE, 2 BGG, 2 BIG, 2 BM, 2 BRC, 2 BSC, 2 BY, 2 CBG, 2 CC, 3 ADQ, 3 BCO, 3 BG, 3 BSS, 3 BTA, 3 BWT, 3 CBL, 3 CC, 3 CHG, 3 MUE, 3 OT, 4 FG. French: 8 AQ, 8 BO, 8 BV, 8 CT, 8 DE, 8 DU, 8 ÉE, 8 GG, 8 GK, 8 GO, 8 HSG, 8 JV, 8 LLO, 8 LMT, 8 LPR, 8 LR, 8 MG, 8 UD, 8 UK, 8 UU, 8 WV, 8 XR, 8 XU. Dutch: 0 GC, 0 GG, 0 RE, 0 RW, 0 XF, 0 XQ. Belgian: 4 ALS, 4 CD, 4 SA, P 2. Swiss: 9 AB, 9 BR. Swedish: SMYY. Italian: 3 RM, ACD. Rhineland: I CF. Luxembourg: LOAA. Unknown: I OKZ, S 7BD. (o—v—o and o—v—1, frame aerial.) (P. H. Brigstock Trasler.)

Cambridge.
American: 1 CF, 1 CQ, 1 OW, 1 PL, 9 AA, 9 AB, WGH. Canadian: 1 AR. Danish: 7 EC. Belgian: 4 AU, 4 C 2, 4 EAV, 4 KV, 4 MB, 4 OS, 4 RS, 4 YZ. Dutch: 0 RE, 0 RA. Finnish: 1 NA, 2 NM. Italian: 1 MT. French: 8 AP, 8 BR, 8 BV, 8 DGP, 8 DU, 8 ÉU, 8 FI, 8 GI, 8 GIP, 8 GM, 8 GO, 8 GZO, 8 HS, 8 II, 8 LL, 8 MG, 8 MK, 8 MO, 8 NS, 8 SB, 8 SO, 8 SR, 8 SSU, 8 TM, 8 UU, 8 ZZ, 8 ZZF. Unknown: G1L. (o—v—o.)
(L. M. T. Balfour and C. C. Birkinshaw.)

Walthamstow, London, E.
French: 8 AG, 8 AY, 8 AB, 8 BU, 8 BV, 8 BP, 8 BG, 8 DE, 8 FA, 8 FF, 8 FM, 8 FP, 8 GS, 8 GL, 8 GI, 8 GP, 8 GM, 8 HS, 8 LP, 8 LM, 8 PS, 8 PA, 8 RG, 8 SM, 8 TM, 8 TO, 8 UK, 8 YG. Belgian: 9 NR, 9 QS, 9 AU. Dutch: 0 BA, 0 RE, 0 GA, 0 NK. Miscellaneous: 3 AF, 3 SS, 1 CF, SMYY, SRK.
(H. W. Webb, 6 OV.)

REPORTS, PLEASE.

Reports on his transmissions are welcomed by Mr. A. E. MacFarlane (6 RM), of 30 Vincent Road, E. Croydon, Surrey. Transmissions are C.W. and telephony.

2 APR.

We should be glad if the Secretary of the "Waveley" Radio Club, owning the call sign 2 APR, would advise us of the locality in which the station is situated.

5 WR.

If all transmitters who have worked with 5 WR would please refrain from calling up that station or addressing correspondence to the late Mr. C. S. Morriss, his parents would be grateful.

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The Dublin Wireless Club, which was founded in 1913, is doing active work for the Free State amateur.

An instructive lecture on "Inductance and Capacity" was provided on January 8th by Mr. W. A. Beatty, who dealt with the practical side of the subject by comparing various types of coils and condensers. The use and abuse of reaction was also explained and the lecturer gave an interesting demonstration with a wireless receiver.

* * * *

"Surprise Nights" have become a frequent feature on the programme of the Hackney and District Radio Society. Such an evening was held on December 29th, when members were asked to write questions on slips of paper. These were then handed round and answered by other members, a very useful discussion resulting.

At the Annual General Meeting of the Society, held on January 5th, Mr. E. Cunningham was elected chairman, Mr. H. A. Epton being appointed as Vice-Chairman. The remainder of the evening was devoted to the sale of the Society's spare apparatus.

* * * *

The use of single layer coils, wound edgewise, to keep self-capacity at a minimum was strongly advocated by Mr. T. P. Allen, B.Sc. lecturing before the Belfast Y.M.C.A. Radio Club on January 2nd. Mr. Allen's lecture covered the problems of inductance, capacity and resistance, and much useful information was given on the calculation of coil values with a view to getting the best results.

* * * *

A highly successful and well-attended "Gadget Night" was held by the Ilford and District Radio Society on January 6th. Members had been asked to bring along any novel or ingenious idea or component which they had evolved, and thanks are due to all those who so ably responded.

Mr. H. L. Vizard described a method of obtaining H.T. current from the supply mains using a potentiometer and filter circuit, while Mr. Dennis exhibited a portable set containing many novel features. Other novelties included a grid leak on a piece of gramophone record and a low capacity valve holder for use in short wave reception.

* * * *

The first Annual General Meeting of the Golders Green and Hendon Radio Society was held on January 7th, when Mr. Maurice Child, the retiring President, gave a brief résumé of the year's work. In addition to an excellent programme of lectures, the Society during 1924 held three field days and a carnival dance.

The new President of the Society is Mr. Leslie McMichael, M.Inst.R.E.

* * * *

In response to many requests from local enthusiasts, the Beckenham and District Radio Society has decided to hold an Exhibition and Competition on or about April 1st next. It is hoped that a number of prominent manufacturers will take stands. Public appreciation of such an exhibition is likely to be very marked and a large attendance is expected.

* * * *

"Transmitting" formed the title of an instructive lecture recently given by Mr. W. Gravett before the Dorking and District Radio Society. Mr. Gravett's transmitting set, constructed by himself, aroused considerable interest.

* * * *

An excellent lecture on short wave reception was given by Mr. J. E. Nickless (2 KT) before the Streatham Radio Society on January 14th. A good discussion followed the lecture, and much useful information was gained. The audience particularly enjoyed Mr. Nickless's accounts of humorous incidents in the early days of transmission.

FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 21st.

Radio Society of Great Britain. Ordinary Meeting. At 6 p.m. (refreshments at 5.30). At the Institution of Electrical Engineers, Savoy Place, W.C.2. Presidential address: "Matter and Radiation," by Sir Oliver Lodge, D.Sc., LL.D., F.R.S.

Clapham Park Wireless and Scientific Society. At 7.45 p.m. At 67 Balham High Road. Testing Night.

Radio Research Society, Peckham. Lecture: "External Heterodyne Reception." Discussion: "Single Circuit and Double Circuit Receivers."

THURSDAY, JANUARY 22nd.

Bournemouth and District Radio Society. At 7 p.m. In the Canford Hall, St. Peter's Road, Southern Railway Company Film: "The Electrification of the S.W. Section of the Southern Railway."

Luton Wireless Society. At 8 p.m. At the Hitchin Road Boys' School. Discussion of Difficulties.

Beckenham and District Radio Society. At 8.15 p.m. Lecture: "Extra Short Wave Transmission." By Lt. Walker (2 OM).

Dublin Wireless Club. Loud Speaker Demonstration.

FRIDAY, JANUARY 23rd.

Sheffield and District Wireless Society. At 7.30 p.m. At Department of Applied Science, St. George's Square. Competition.

TUESDAY, JANUARY 27th.

Institution of Electrical Engineers (North Midland Centre). At 7.30 p.m. At the University, Leeds. Faraday Lecture on "World-Wide Radio Telegraphy," by Professor G. W. O. Howe, D.Sc.

Manchester and District Radio Transmitters' Society. Lecture: "Condensers." By Mr. P. R. Coursey, B.Sc.

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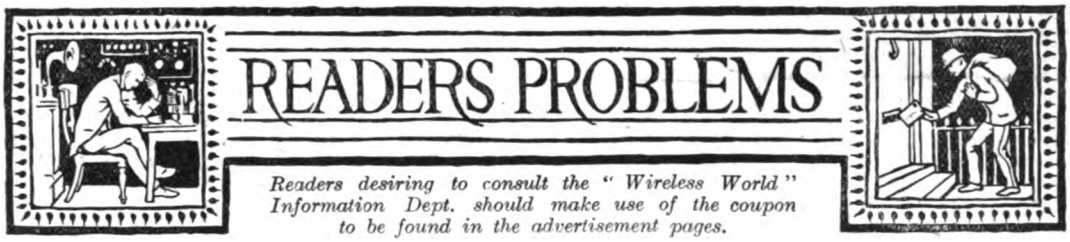
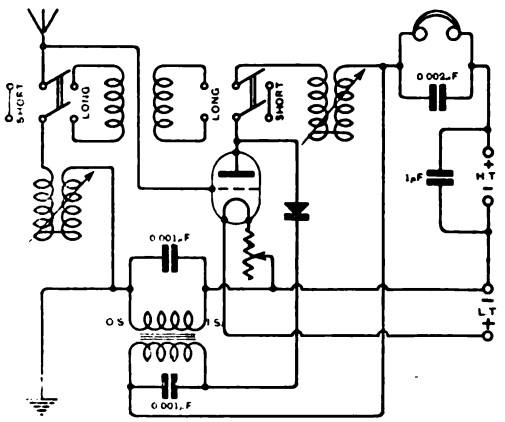

READERS PROBLEMS
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

A ONE-VALVE REFLEX CIRCUIT FOR HIGH AND LOW WAVELENGTHS.

A READER has asked for a diagram of a reliable one-valve reflex circuit suitable for receiving the B.B.C. stations and also Chelmsford and Paris without using either plug-in coils or condensers.

We illustrate below a circuit suitable for this purpose. Variometer tuning is employed and reception of the long wave stations is accomplished by bringing into circuit loading coils by means of D.P.D.T. switches. These switches may be of the anti-capacity type and a single four-pole switch may be used if desired in place of the two switches. The loading coils may be basket or slab wound and as they are cut completely out of the circuit on the lower wavelengths undesirable "dead end" effects are eliminated. It is, however, desirable that they should be placed as far away from the variometers as possible and they should be placed at an angle to each other.



A single valve reflex set suitable for the reception of B.B.C. stations, Chelmsford and Paris.

No attempt is made in this circuit to deliberately introduce magnetic reaction and the absence of this considerably simplifies tuning and prevents the set "buzzing," a very annoying feature in dual circuits containing both magnetic reaction and one or more L.F. transformers. The correct connections of the I.P. and O.P. terminals of the transformer must be determined by experiment and it is also advisable to experiment with the values of the fixed condensers across the windings of the transformers and telephones. This circuit will be found extremely stable and productive of good results.

PREVENTION OF AMPLITUDE DISTORTION IN A CHOKE COUPLED AMPLIFIER.

ON page 302 of the December 3rd issue of this journal a method was described for preventing overloading of the last valve of a choke coupled amplifier due to strong local signals by means of altering the value of the grid leak of the final valve by means of clix sockets. It will be appreciated that if incoming signals are of considerable amplitude, distortion will occur due to the voltage swing applied to the grid of the final valve being of sufficient amplitude to pass beyond the limits of the straight line portion of the grid volts anode current characteristics. This can be prevented by lowering the value of the grid leak associated with the last valve.

SUGGESTIONS FOR INCREASING EFFICIENCY ON LOW WAVELENGTHS.

WE receive many queries from readers for three and four valve circuits suitable for reception on all wavelengths, that is of course, from about 150 metres upwards, since the ordinary standard types of circuit using commercial plug-in coils are quite unsuitable for dealing with the wavelengths below this limit.

The losses due to small stray capacities which are relatively unimportant on the broadcast wavelengths and quite negligible on long wavelengths are absolutely fatal to efficiency when dealing with wavelengths below 150 metres; in fact it will be found that even on the 200 metres wavelength the efficiency of the ordinary receiver is markedly less than on the broadcasting band of wavelengths. This is partly due to the fact that condensers of fairly large maximum and minimum capacity are usually employed in these receivers.

It is therefore advisable when working below about 250 metres that the capacities of the variable condensers employed should be kept as low as possible and should not exceed 0·0002 μF maximum value under ordinary circumstances. Unfortunately,

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however, a condenser having such a low maximum is not very useful on long waves inasmuch as the variation of wavelength obtainable with such a small capacity range will be extremely limited and a very large number of coils will be required. It is of course quite impracticable for the variable condenser to be changed for different bands of wavelengths, but an excellent plan to overcome this difficulty, which is but little employed among amateurs, is to mount small clips in parallel with the variable condensers into which "clip-in" condensers of varying values can be inserted when desiring to receive on the longer wavelengths. It is obviously more convenient and less costly to have a large range of fixed condensers of this type than to have a large number of expensive and bulky coils.

Resistances for H.F. Amplification.

A CORRESPONDENT has written to ask whether the remarks made on page 379 of the December 17th issue of this journal concerning anode resistances for L.F. amplification are equally applicable in the case of H.F. amplifiers designed for use on long wavelengths.

The anode current of valves employed for H.F. amplification is usually not so great as that of valves for L.F. amplification. Hence anode resistances of the grid leak type are not so noisy as they would be when connected in an L.F. amplifier. However, if several stages of resistance coupled H.F. amplification are employed, a noise that is sufficient to be undesirable may be heard unless the resistances are carefully chosen. Wire-wound resistances may, of course, be employed, provided they are wound to have a negligible value of self-capacity and inductance.

Causes of Low Frequency Howling.

FROM time to time we receive complaints from readers troubled with low frequency buzzing or whistling in their receivers. This trouble cannot, of course, be cured by adjusting reaction, and the note will not change its pitch when tuning controls are moved as in the case of high frequency oscillation. The tone varies from a low growl to a high-pitched whistle according to the constants of the L.F. portion of the receiver. It is, of course, caused by the low frequency valves oscillating at audible frequency. This is due usually to either a magnetic or capacity coupling between the input and output sides of the amplifier. This can best be avoided by carefully spacing all the L.F. components of the circuit, taking care that transformers are not adjacent to each other and placing their cores at an angle to each other if possible. Care must also be exercised in spacing the wiring carefully so that grid and anode wires do not run parallel to each other for any great distance. Provided this is done very little trouble will be experienced from the causes we have mentioned. It is far better to exercise care in this respect when the set is being constructed than to resort to the placing of condensers and resistances in various portions of the circuit in order to eliminate the trouble.

There is, however, another source of trouble, which is often productive of instability in the L.F. amplifier. This is due to having a high resistance in the circuit, such as the H.T. battery, which is common to the anode circuits of all the valves. Varying potentials are set up across this high resistance which are, of course, communicated to all the valves in the common anode circuit, with the result that low frequency oscillation is set up. The use of a condenser of large capacity (such as 2 μF) across the H.T. battery will do much to remedy this, besides acting as a filter for any crackling noises set up by a defective battery. In one case which was recently brought to our notice, the trouble was eventually traced to the use of a wander plug containing a high resistance designed for the protection of the filaments should the H.T. wiring accidentally come into contact with the L.T. wiring of the receiver. This plug was used as the H.T. + connection for all valves, no separate tappings being provided, and its resistance was sufficient to cause the trouble we have mentioned. The use of a grid battery common to all L.F. valves is also another possible source of trouble if it should happen to be of high resistance, and a 2 μF shunting condenser can be used with advantage in this portion of the circuit.

Methods of Controlling the Grid Potential of Power Valves.

A CORRESPONDENT proposes to add an L.F. amplifier, using a valve of the D.E.5 type, to his valve receiving set, and desires to know if he can use a potentiometer in conjunction with dry cells of the bell-ringing type in order to get a fine adjustment of grid bias for this valve.

It is certainly possible to obtain a far finer adjustment of grid bias by this method than by the more usual method of using a small H.T. battery and wander plugs, and the only point which necessitates consideration is the probable life of the cells concerned. The usual resistance value of the ordinary potentiometer used in wireless receiving sets is approximately 300 ohms, and as it is desirable that five dry cells be used the value of the current flowing in the potentiometer windings will be 0·025 amps. A switch should be included in the circuit in order to prevent the cells dissipating their energy through the potentiometer windings when the set is not in use. It is then probable that, using the set three or four hours daily, the cells would last four or five months.

The importance of providing a suitable grid bias for valves working as high or low frequency amplifiers cannot be over-estimated. Without grid bias there is certain to be distortion, regardless of the type of intervalve coupling employed.

There appears to be a misunderstanding regarding resistance coupled amplifiers. Correct grid bias is just as essential when this method of coupling is employed as when intervalve transformers are used—in fact a resistance coupled amplifier will usually give signals of poor quality when no bias is employed compared with those obtained from a suitably adjusted transformer coupled amplifier.

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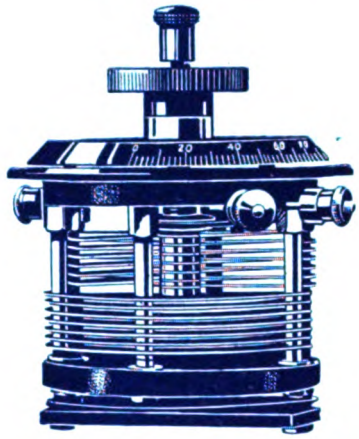
DUBILIER PRODUCTS



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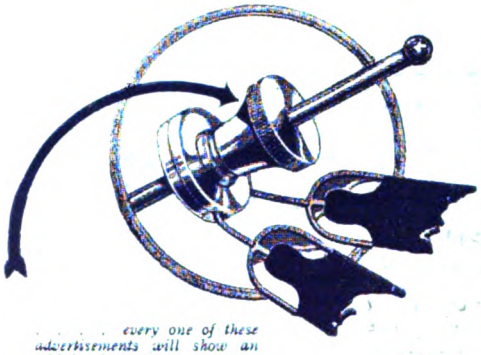

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THE WIRELESS WORLD AND RADIO REVIEW

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MAY 19 1925

THE DESIGN OF A COMBINED CRYSTAL SET AND BUZZER WAVEMETER

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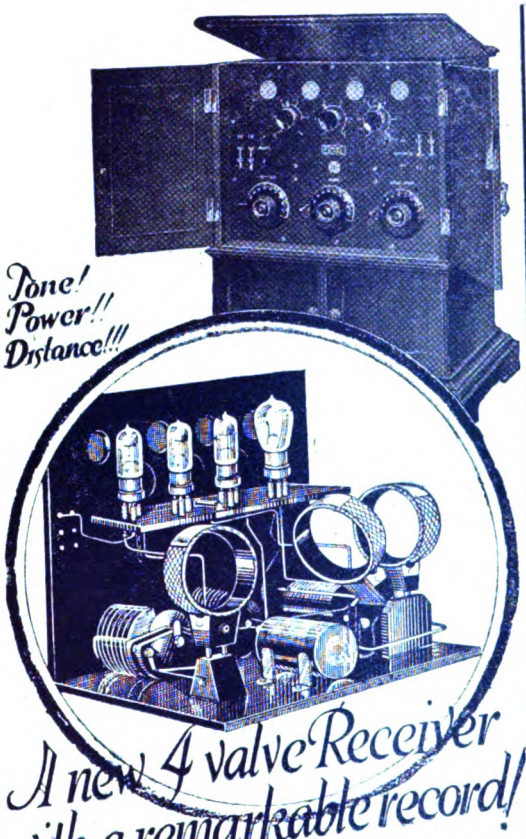

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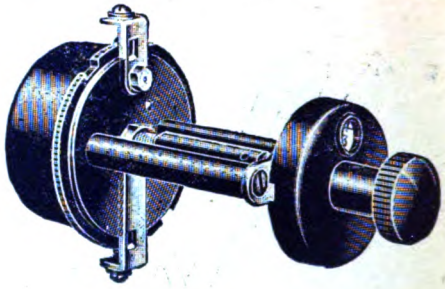

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The WIRELESS WORLD AND RADIO REVIEW

RADIO TOPICS.

By THE EDITOR.

BROADCASTING AND EDUCATION

THE British Broadcasting Company has taken up energetically the question of utilising broadcasting as a means of education in schools. The Company announces that they are in touch with every local educational authority in the country, school inspectors and members of educational advisory committees, with reference to their new programme of talks, lectures and school transmissions which are to be broadcast from all the B.B.C. stations simultaneously between now and the Easter vacation. The B.B.C. has been encouraged in its efforts in this direction by the keen interest which has been shown by a very large proportion of those responsible for school education. It is pointed out that, quite apart from the material which is broadcast for educational purposes in the ordinary way, there is the very distinct advantage that ordinary studies can be supplemented by lectures on special topics, by eminent authorities who whilst they can devote the time to broadcast single lectures could not possibly visit individual schools to lecture under the same arrangement. Broadcasting therefore provides the only means for students to attend authoritative lectures of this character.

The Schools Radio Society, which is a section of the Radio Society of Great Britain, was formed for the purpose of encouraging the use of wireless in schools for this purpose and also for the actual instruction of students during school hours in the elementary theory and practice of wireless. The Society has done a good deal to stimulate interest but still seeks more support from schools and colleges throughout the country.

It is unfortunate that just at the present time when such a big effort is being made by the British Broadcasting Company and other interests to encourage the adoption of wireless as a means of education that an important educational body in this country should recently have announced that it does not propose to give any active support to the movement nor to authorise any grants to assist schools to acquire the necessary receiving apparatus.

The reason given for this decision is that in their opinion the degree of intelligibility obtained from loud speaker reproduction has not yet reached a stage of development when lectures can be followed easily by young students. It would be well if in coming to such a decision this educational body had stated on what evidence this decision had been based. It is easy to understand that persons who have had no experience of good reception might be capable of denouncing wireless reception in this fashion, but in our opinion, before a responsible body came to such a decision, a thorough investigation of the matter should have been undertaken. We are confident that on the score of intelligibility it would have been possible to demonstrate that, properly handled, a suitable wireless receiver leaves very little, if anything, to be desired. It is true, of course, that to produce speech at loud speaker strength so that it is a perfect reproduction of the original is not an easy matter, but when it comes to a question of intelligibility it has long been recognised that it is possible not only to reproduce the same degree of intelligibility but even to improve upon the original in this direction.

We note that part of the scheme of the British Broadcasting Company in their educational programme is to instruct a local representative at each of their broadcasting

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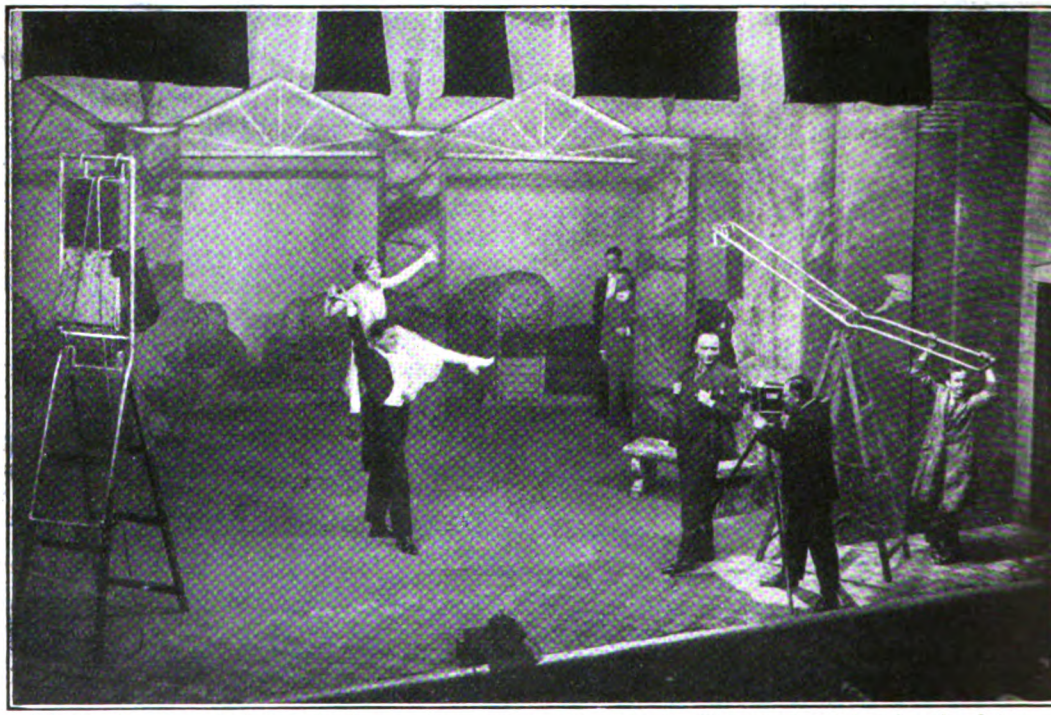
stations who will give, on request, free advice to teachers and educational officials on the equipment of their schools with apparatus specially suitable for the purpose and economical in initial cost and upkeep. In view of these special facilities and the enterprise of the B.B.C. in starting these programmes, we feel that it should be regarded as incumbent upon educational authorities who have so far disregarded the value of wireless to reconsider the whole question in the light of these new circumstances.



Filming the scene which was simultaneously screened and broadcast. The experiment is referred to below.

BROADCAST FILM EXPERIMENT.

THE pioneer attempt made the other day to synchronise the music of a play being broadcast with a cinematograph picture of the same performance was distinctly interesting even though the results may not have been entirely successful from a practical point of view. The fact however, that the cinematograph picture was taken at a different performance from that when the music was broadcast, made the problem of synchronising the two almost an impossible one. The experiment was no doubt suggested as a result of the success of recent demonstrations of what has come to be known as the "speaking film" and described recently in this journal. The great advantage which the latter system has over one where broadcasting is done independently is that the difficulty of synchronising the two is completely overcome. We believe that the future of the speaking film is assured but it is doubtful if it is worth while to continue experiments where broadcasting is done independently of the film as attempted the other day, unless some new system is first devised to give a greater assurance of success in the matter of synchronising the two operations.

The possible solution to the difficulty which naturally presents itself is for a film or other form of record of the music to be made at the same time as the cinematograph picture is taken, and for this record to be used afterwards to control the broadcast transmitter. If this were carried out the difficulty of synchronising the two would be reduced to merely the necessity of bringing the two into step.

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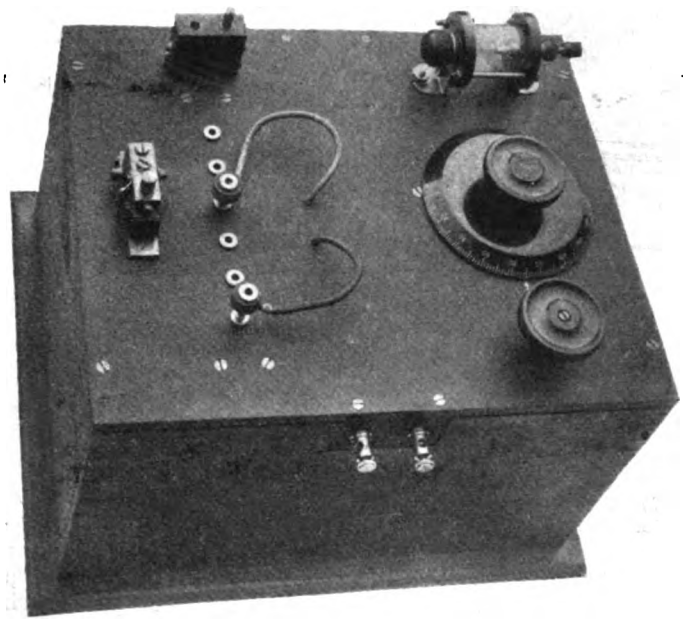

The finished instrument. On the left is the buzzer, the loading coil holder and the Clix plugs and sockets tapping the coil. On the right is seen the switch, tuning condenser, and crystal detector. The telephone terminals are in front.

IDEAL RECEIVERS —III.

A COMBINED CRYSTAL RECEIVER AND BUZZER WAVEMETER FOR ALL WAVELENGTHS.

By W. JAMES.

DESIGN OF THE INSTRUMENT.

THIS instrument is primarily a crystal receiver; to it has been added a switch, a buzzer and a battery, in order that it may also be employed as a buzzer wavemeter.

It has been shown by careful measurements that for best results

(*a*) A good coil must be employed.

(*b*) When a tuning condenser is used in the aerial circuit, and the set is to receive signals over the broadcast band of wavelengths, the condenser must be connected in series with the aerial, and further, it must not be set at a value lower than about 0·00025 microfarads. When tuning to longer wavelengths, however, such as 5 XX (1,600 metres), it is permissible to employ a tuning condenser connected in parallel with the tuning coil, provided only a small value of capacity is employed.

(*c*) The design should be such that the crystal detector can be tapped across a portion of the tuning coil, and not the whole coil, as is usually done. The best adjustment of the crystal detector circuit depends on the high frequency resistance of the crystal detector—which may, in the case of the wire contact type, be between 1,000 and 5,000 ohms, according to the particular crystal employed—and the resistance of the aerial-earth system. Obviously the best adjustment for a detector having a resistance of 1,000 ohms is not the best when a different crystal which may have a resistance as high as 5,000 ohms is employed.

It is, of course, essential so to arrange the components that tuning may be effected easily—for instance, the detector should be placed where it may be critically set and not liable to be accidentally moved when adjusting the condenser or arranging the tapping plugs.

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(*a*) In most instances the crystal receiver will be required to tune over the broadcast band of wavelengths (say 300-500 metres) and also to 5 XX (1,600 metres). We may therefore employ one coil for the lower band of wavelengths, and add a loading coil when tuning to 1,600 metres or higher wavelengths The loading coil may be removed from the set and the connections for this coil short-circuited when receiving the lower wavelength signals. There will then be no losses through dead end effects such as would be produced if the loading coil were mounted permanently in the set and simply disconnected when not required. The connections of the coils may be seen from Fig. 1, where LC is the socket for the loading coil.

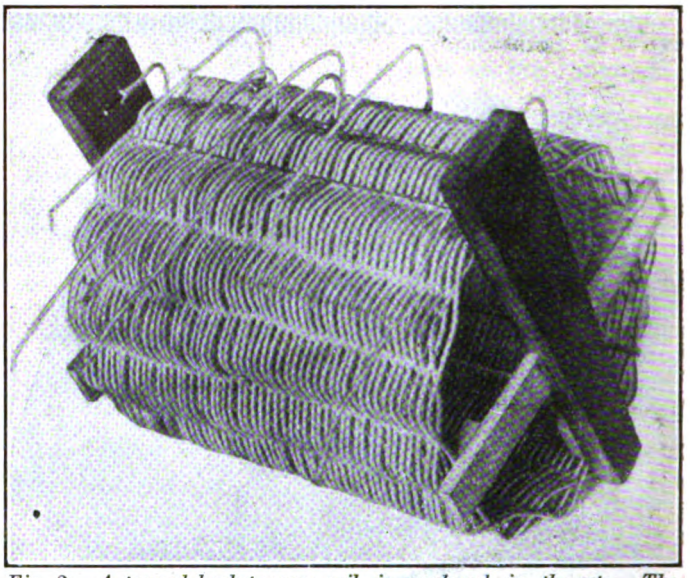

Fig. 2. A tapped basket-weave coil is employed in the set. The photograph shows the tapped coil, and the supporting end pieces of wood.

As to the coil used to tune over the lower band of wavelengths, and which is permanently secured in the set, it is well known that this coil should have the lowest possible high-frequency resistance. It should therefore be wound with a fairly thick wire, have its turns spaced, and be as nearly self-supporting as is consistent with mechanical strength.

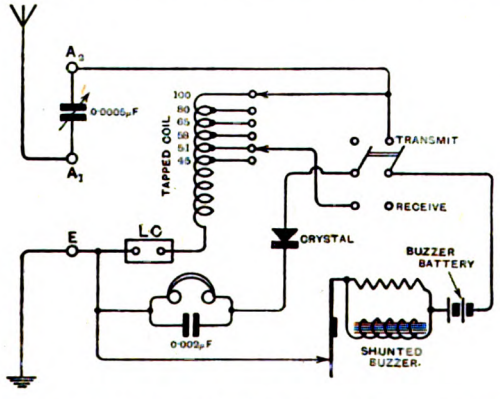

Fig. 1. The theoretical diagram of the set. When the aerial is connected to A_1 and the earth to E, and the switch is put in the position marked "Receive," the variable condenser is in series with the aerial and the coil, and the crystal detector and telephones are connected to the coil for reception. By putting the switch to "Transmit," and connecting terminals A_1 and E with a piece of wire, or a small coil, the set may be used as a buzzer wavemeter.

The effect of employing a solid former, such as a cardboard or ebonite tube upon which the turns are wound is to add considerably to the resistance of the coil and so to reduce the signal strength. The coil used in this receiver is of the basket-weave type, and is illustrated in Fig. 2. This type of coil is practically self-supporting, has spaced turns and is easily wound, and, of course, is much more efficient than an ordinary single-layer coil of similar inductance wound on a solid former. For a coil of the basket-weave type tuning over 300-500 metres, the best size of wire from the point of view of maximum efficiency is about No. 18 copper. Ideally, of course, bare wire would be employed, but practically it is difficult to construct a coil for a receiver of this type of bare wire. Further, the method of winding is such that the turns touch where they cross between the pegs of the former which is used for winding; therefore a double cotton covered wire is employed to give the conductor itself a reasonable spacing.

It was pointed out above that it is essential to tap the detector circuit across a portion of the coil or alternatively so to arrange the ratio of capacity to inductance that the required conditions are met. The best position for the detector tapping depends partly on the aerial-earth system,

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but mainly on the H.F. resistance of the crystal detector, which naturally will be different for every specimen of crystal. It is therefore necessary to find the best position for this tap by experiment. If the detector is connected across the whole of the coil, it is usually found that tuning is flat and signals weak. By adjusting the circuit the signal strength may be brought up and the selectivity of the set considerably improved.

We must therefore take taps from our coil, and do it in such a way that the losses of the coil are not increased. The losses would be increased, for instance, if we took a number of taps, ran the tapping wires together, and connected them to studs mounted close together in the ebonite panel. In this set we connect the taps at suitable points, mount the coil in such a manner that the tapping wires are short and well spaced, and provide contacts in the form of Clix sockets, which are mounted $\frac{3}{4}$ in. apart in the panel.

(*b*) A tuning condenser of 0·0005 microfarads capacity is employed. It is connected as indicated in Fig. 1. When the aerial is connected to terminal A_1 and the earth to terminal E, this condenser is in series with the aerial. To put the condenser in parallel with the tuning coil for the reception of long wavelength signals it is only necessary to connect terminals A_1 and E by a wire, and to connect

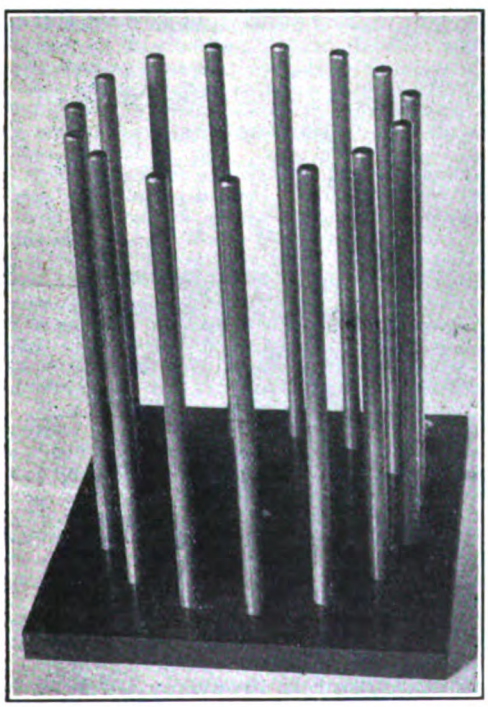

Fig. 3. The former on which the coil illustrated in Fig. 2 was wound. It consists of 15 lengths of brass rod let in a piece of ebonite or wood.

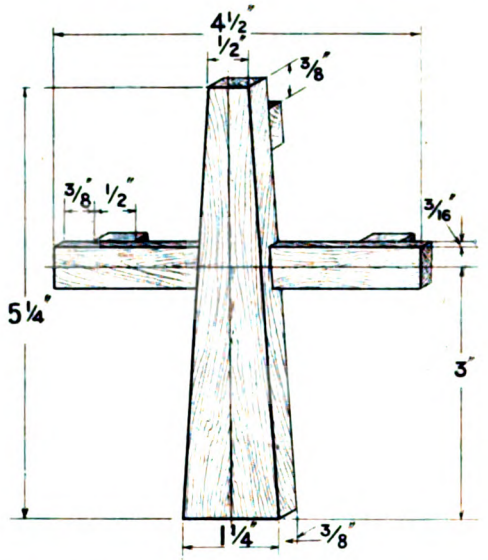

Fig. 4. The coil is fixed to the ebonite panel of the instrument by two supports of wood arranged as indicated here.

the aerial to A_2 and the earth to E. When the instrument is to be used as a wavemeter, terminals A_1 and E may be short-circuited, when we have an ordinary tuned circuit comprising a condenser connected across a coil. Alternatively, we may connect between A_1 and E a small coil having long leads, and say 5 turns about 2 ins. in diameter, and use this coil to induce the oscillations set up in the wavemeter into the circuit to be excited.

When receiving signals it will be found that signals are weakened if the tuning condenser is set at a value below about 0·00025 microfarads. With ordinary aerials which have a capacity of the order of 0·00025 microfarads not much is gained by employing a tuning condenser having a capacity over 0·0005 microfarads in series with the aerial.

(*c*) We have taken care of requirement (*c*) by providing a tapped coil as in (*a*) above. The best position for the detector tap for maximum signal strength and best selectivity will depend on the crystal, different specimens having widely different characteristics.

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Experiment, however, will soon indicate the best adjustments.

THE TAPPED COIL.

A photograph of the tapped coil and the former upon which the coil is wound appears as Figs. 2 and 3. The former consists of a piece of ebonite or wood measuring about 6 ins. square with 15 lengths of ¼ in. brass rod fitted uniformly on the circumference of a circle 4 ins. diameter. The lengths of rod are 6 ins. long, and are a tight fit in the holes provided in the base of the former. There is no need to screw the holes in the base and the ends of the rods. It is advisable to drill the holes through the base, for then it is an easy matter to punch the rods out of the base when required.

To wind the coil it is only necessary to secure the end of wire, and to wind the wire on the outside of the first peg, on the inside of the next peg, then on the outside of the next peg, and so on. It will be found that the pegs will bend inwards if the wire is pulled. Therefore do not pull the wire, but rather bend it round the pegs with the fingers, allowing the base of the former to rest flat on the table.

The coil is complete when 100 turns are wound. Pass a length of thread at intervals through the spaces of the turns to secure them. Then at the tapping points, which are clearly marked in Fig. 1, bare the wire for about ¼ in., place a piece of empire cloth beneath the points, and solder short lengths of wire. Finally remove the lengths of rod from the former and so release the coil.

Next prepare the supports for the coil. These are sketched in Fig. 3, and are constructed of wood. The wide ends of the supports are screwed to the panel as will be shown in the next number.

(To be concluded.)

A WORD FOR THE TRANSMITTER.

A timely statement on the position of the amateur transmitter in relation to the broadcast listener was made by Mr. H. Bevan Swift, the recently elected Chairman of the Transmitter and Relay Section of the R.S.G.B., in a speech from 2 LO on January 22nd.

"The holder of a transmitting licence," said Mr. Bevan Swift, "enjoys privileges granted by the Postmaster-General to carry out experimental work upon a fixed wavelength of 440 metres, a band from 150 to 200, and in a few cases, extremely low wavelengths. The first, being within the broadcast band, is prohibited during broadcast hours. No such restriction exists regarding the lower wavelengths, and the experimenter is free, according to the terms of his licence, to work during any hours. The majority of experimenters have, however, made it a strict rule with themselves never to work during the hours of broadcasting simply because they know that the unselective receiving sets surrounding them would pick up the emitted waves. They have no wish to incur the wrath of the broadcast listener, or to jeopardise their privileges, so that they wisely refrain from exercising their legal rights until the last strokes of Big Ben have tolled the close of the broadcast day.

"The extension of broadcast hours have more and more curtailed the available working time, so that the experimenter has become a man of extremely late, or rather early, hours. His patience in this respect is not appreciated, for few broadcast listeners know the real circumstances. On the other hand the experimenter is frequently blamed by inconsiderate listeners for every Morse message or other interference heard. Such judgment is very unfair, although the idea appears to be prevalent, and very few experimenters have escaped the impeachment. The interference is generally due in the case of Morse messages to ships or high power coastal stations, coupled with the fact that the average receiving set is hopelessly unselective.

"The trouble would be obviated if the receiving sets used for broadcast made more use of the coupled circuit advocated in the technical press, and recently by Captain Eckersley. This would cut out all interference and sharpen the tuning of the set to the desired station. It is so simple and easy to apply that every receiving set should have it. In most cases it would consist of an extra coil to which the aerial and earth would be connected, instead of their usual terminals. Any radio dealer could easily fit this at a small charge. It further would give the user the advantage of being able to receive other stations than the one he usually receives. If every set had this the great bulk of complaints would disappear, and we should hear less of the interfering transmitter.

"The experimenter has already performed wonders in radio research work, of which he is justly proud. Although limited by the small powers permitted he has shown the radio world the value of ultra short waves for long distance work. Intercommunication with American experimenters is now a customary nightly occurrence, while two-way working with Australia and New Zealand has also been established.

"Nobody wishes to see the British experimenter hampered in his research work so that other countries would have an unfair advantage, and upon this ground the Transmitter and Relay Section of the Radio Society of Great Britain makes an appeal for more considerate dealing from the great body of broadcast listeners."

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THE IMPORTANCE OF FILAMENT CONTROL.

In this short article the author shows how careful control of the filament current is an aid to fine tuning.

By R. J. BANN, B.Sc.Tech.

IT is often very surprising, in these days of comparative enlightenment on the theory of thermionic valves, to note how very many well-informed wireless enthusiasts quite fail to realise the great importance of filament control in valve receiving circuits. This question is rarely dealt with with the thoroughness which I submit is its just due. Most people realise that the operation of the thermionic valve depends entirely upon electron emission and the terms "saturation current," "backlash current" and the like, are, I believe, quite familiar to most students of this extremely fascinating branch of wireless reception. In the following study of these points an attempt is made to show the great possibilities of some kind of fine control—

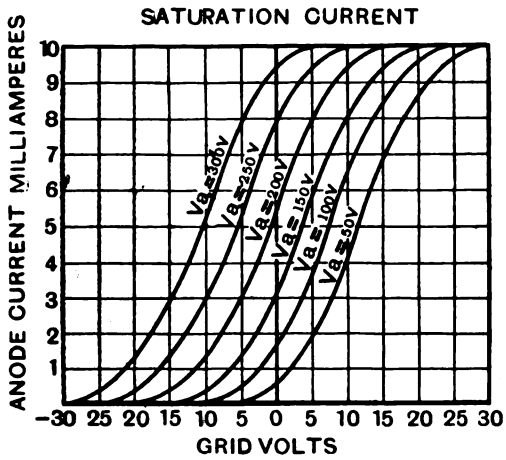

Fig. 1. Ordinary characteristic curves showing the relationship of anode current to grid volts for various anode voltages.

let us call it "vernier" control—on the electron emission from a valve filament. First it should be noted that this control is most effective when used in a circuit employing regenerative amplification or reaction, dual amplification or circuits employing combinations or variants of these

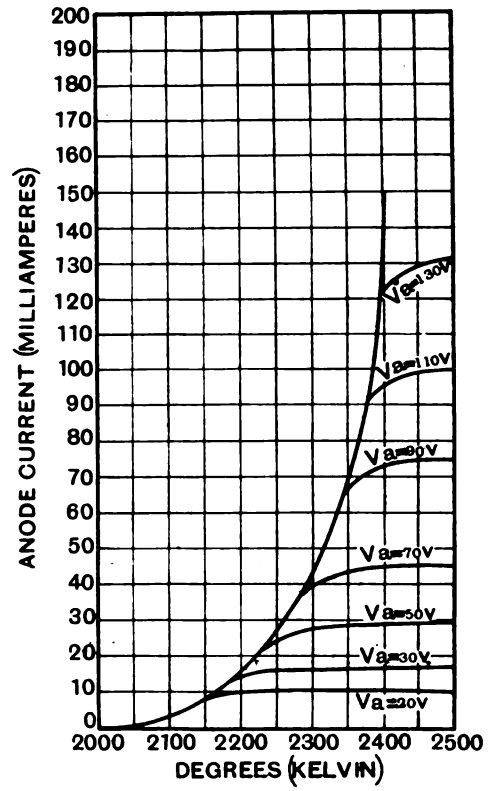

Fig. 2. Curves showing the variation of anode current with filament temperature.

features. At the same time too much importance cannot be attached to fine filament control with straight circuits.

CASE 1.

In Fig. 1 we have the familiar anode current—grid volts characteristic for a

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simple valve. The features of the curves are :—

(*a*) The reverse grid potential required to stop all electron flow (anode current zero).

(*b*) Saturation current, when further increase in plate voltage produces no appreciable increase in anode current.

From the nature of the various curves it will be clear that increasing the anode current does not affect the nature of the characteristic but pushes the curve to the left. It is, of course, assumed that the filament temperature is constant in the above argument.

CASE 2.

In Fig. 2 we have the order of things reversed, the anode voltage being constant for any one curve and the filament emission variable. It will be seen that the effect of increasing the filament emission is to push the curve upwards. The curves shown are emission curves for an ordinary hard valve with a tungsten filament.

CASE 3.

In Fig. 3 we have a sketch of an arrangement whereby the normal grid potential may be controlled by a potentiometer of about 300 ohms resistance. This method results in moving the curve (see Fig. 1) to the left or right at will. Experiment has shown that the saturation current of any valve is the same whether the grid is there or not when the grid is neutral with respect to the filament. That is to say, saturation current is the same for a given two-electrode or three-electrode valve, other things being equal. Referring to Fig. 1, we see that the anode current increases with increasing grid potential. Therefore for greatest amplification the grid potential apparently must be raised. Actually, as is well-known, such increase has serious drawbacks, since a portion of the electron stream will be " absorbed " by the grid, resulting in a decrease in anode current and often some rectification and distortion due to grid current. For best results the valve should therefore be worked on the straight line portion of its characteristic on the negative side of the point of grid volts. Simply, this may be effected by careful control of filament emission and plate potential since any electrons striking the neutral grid will tend to make its potential negative with respect to the filament. The above follows from previous observations that increase in plate volts moves the characteristic to the *left* or negative side and increase in emission raises the limit of saturation and thus increases magnification.

CASE 4.

There is still another aspect of our study and that is the effect of anode current on the interchange of electro-magnetic energy from the plate circuit to the grid external circuit, or what we know as " reaction." For the purpose of our present study it will suffice if we consider the reaction introduced by means of a coil in the plate circuit coupled to the aerial coil or the secondary coil of a loose-coupled tuner. Everybody knows that

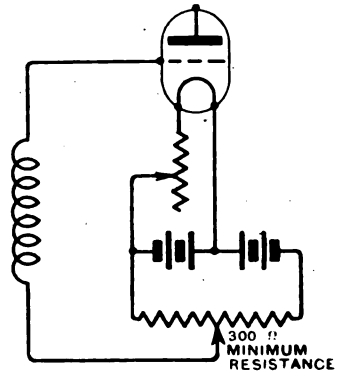

Fig. 3. A potentiometer is included in the grid circuit of the valve to give control of the grid potential.

between two coils so coupled in circuits which are in resonance with the same frequency, there is an interchange of electro-magnetic energy producing a feed back effect from the coil in the anode circuit to that in the grid circuit. This extra energy input to the grid circuit tends to neutralise the damping losses and ohmic losses in the latter and an increase in signal strength results. Now the amount of regeneration thus produced is proportional to the *mutual* inductance between the two coils, which is again proportional to the tightness of the coupling (*i.e.*, to the distance of one coil from the other).

The magnetic flux being proportional to the current passing through the coil, teh regenerative effect will depend on the current flowing in the anode circuit. In other

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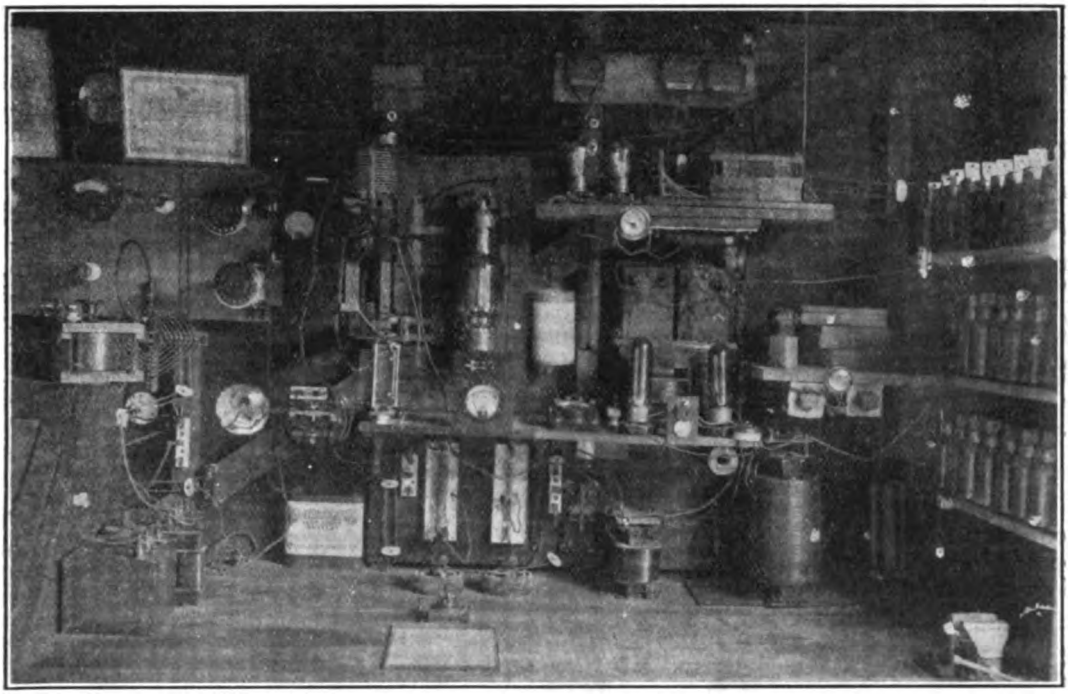
words, reaction in any receiver may be controlled by varying the electron emission from the filament. The same arguments will clearly hold good in a different and more direct sense with a receiver employing dual amplification, since the rectified current which is a measure of the filament emission is fed back for reamplification to the grid of the valve. It is often remarkable how patient and careful filament control is successful in reducing distortion without having to " detune " the set slightly. On a single-valve crystal reflex circuit I have tuned in Birmingham, Aberdeen and London on the filament rheostat alone, without touching the tuning condensers. With a single note magnifier added, Hamburg, Berlin and London have again come in on filament control alone. So that from the theoretical aspect, coupled with results in actual practice, I think there is a clear case for successful reception by controlling the output of the valve at its primary source—the filament. In conclusion I may add that many of my friends are now converted and have become enthusiastic filament controllers.

AN AUSTRALIAN AMATEUR TRANSMITTING STATION.



This photograph depicts the transmitting apparatus at A 2 CM, which is owned and operated by Mr. Charles Maclurcan, of Sydney, N.S.W. It may be mentioned that A 2 CM was in two-way communication with G 2 OD (Mr. E. J. Simmonds, of Gerrard's Cross, Bucks) on November 24th, when the Australian station sent a message for H.M. the King. 2 CM's signals have been received by a number of British amateurs.

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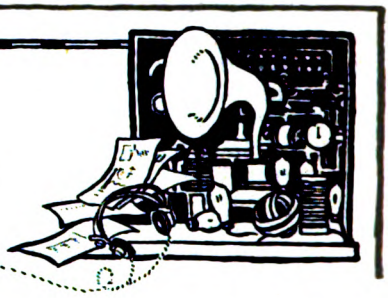
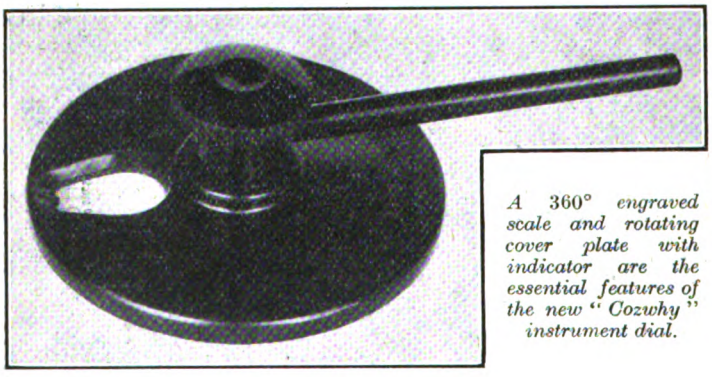
NEW APPLIANCES.



The "Cozwhy" Dial.

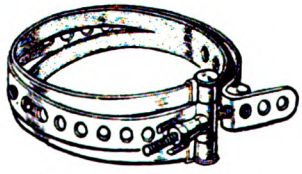
The need for an accurately divided instrument dial marked with degree divisions and with its markings so displayed that they can be easily read, has been met by the appearance on the market of the "Cozwhy" instrument dial. It consists of a cover which rotates with the instrument spindle while the scale remains stationary.



A 360° engraved scale and rotating cover plate with indicator are the essential features of the new "Cozwhy" instrument dial.

The "A.A." Earthing Clip.

Earthing is usually obtained by connection to the water main, making use of a clip to provide reliable connection. The "A.A." clip consists of a double loop of soft brass

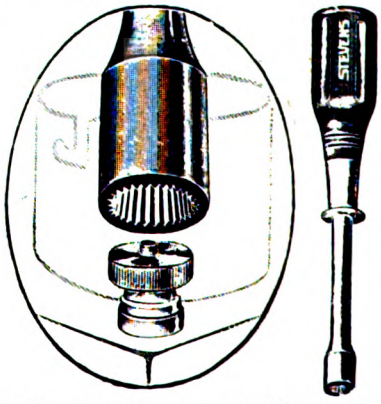


An earthing clip made in brass and designed to provide a good grip round the cleaned surface of a water pipe.

and is adjustable through a wide range to fit pipes of various sizes. A firm grip is obtained, and the earth lead is best connected to a small tag clamped down under the tightening screw. The clip is a nicely finished piece of work, the machined parts being clean and accurately set up.

"Spintite" Wrenches and Box Spanners.

The use of box spanners for tightening up small nuts on the back of instrument panels has already been referred to in the pages of this journal. In instrument construction back-nuts often appear in rather inaccessible positions and if an attempt is made to tighten up with pliers the head of the nut may become damaged, whilst it is sometimes exceedingly difficult to screw up tightly. The "Spintite" wrenches are made in all B.A. sizes, whilst another type is supplied to give a good grip on knurled terminal heads. The use of these tools saves time, whilst a much more positive and effective grip upon nuts is obtained.



The use of box spanners prevents injury of the faces of small nuts, and speeds up the work of assembling components on the panel.

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RESISTANCE COUPLED AMPLIFIERS.

In this paper the author discusses resistance-capacity coupled low frequency amplifiers, and gives the results of measurements taken when an R valve, a D.E.5 valve and a D.E. 5B. valve is employed.

THE advantages of this method of amplification have of late been generally recognised. The principal advantage is that the amplification is almost independent of frequency over the whole range of speech frequencies, and that by the simple expedient of using large coupling condensers the even amplification may be maintained down to the lowest audible notes, such as the base notes of an organ.

A second, though by no means negligible, advantage is the very small H.T. current taken.

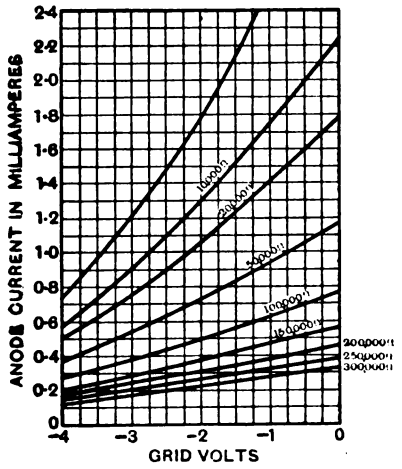

Fig. 1. Anode current grid volts curves with anode resistances connected to a D.E.5 B. valve. H.T. voltage 150.

The chief disadvantage up to the present has been the comparatively small degree of amplification obtainable; for example, with an R or similar type of valve an amplification of about 7 is the maximum; whereas with transformer coupling amplification of from 18 to 35 can be obtained.

However, by the use of specially designed valves having high amplification factors, such as the M.O. D.E.5 B, this can be largely overcome. With such a valve an amplification of about 15 can be obtained.

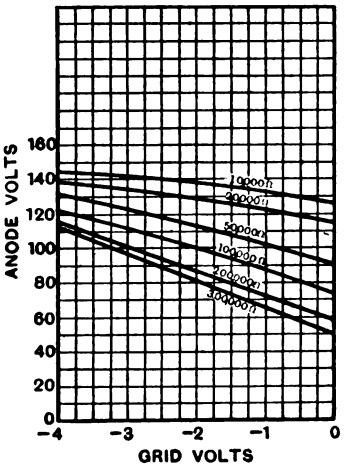

Fig. 2. Anode volts grid volts curves with anode resistances connected to a D.E.5 B. valve. H.T. voltage 150.

The theory of resistance amplification has been often treated; in many cases, however, it is assumed that, having decided on a suitable anode voltage and anode resistance, the H.T. supply is provided accordingly. The more practical problem is: given a definite H.T. supply, what is the best valve and what is the best anode resistance to use with it? Generally speaking, the higher the amplification factor of the valve the better.

It is possible to determine whether a valve is suitable and the best value of anode resistance by taking a series of anode-current grid-volt curves with various resistances in the anode circuit at constant H.T. supply volts.

Such a series of curves for a M.O. D.E.5 B valve are shown in Fig. 1. The H.T. supply was 150 volts, and curves were taken with anode resistances varying from 10,000 to

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300,000 ohms. It will be seen that the insertion of the resistance has not only diminished the anode current, but has at the same time considerably straightened the curves, almost entirely eliminating distortion due to curvature of the valve characteristic.

Suppose the anode resistance is r ohms and the anode current is i amperes, then there will be a voltage drop of ri volts across the resistance. Hence a series of derived curves can be plotted that represent the anode-volts grid-volts relation for each value of anode resistance. Fig. 2 gives the set of curves corresponding to Fig. 1.

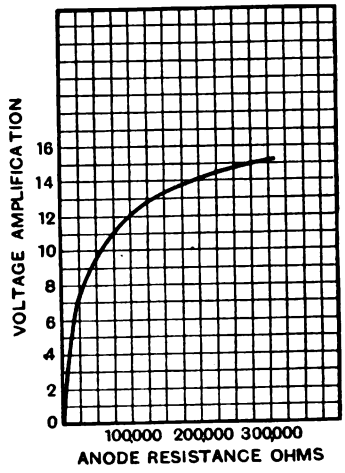

Fig. 3. The voltage amplification with a D.E.5B. and a H.T. voltage of 150.

These curves may also be readily observed by connecting a low reading electrostatic voltmeter either across the anode resistance or between anode and filament negative.

From these curves can be derived another shown in Fig. 3, where the ratio

$$\frac{\text{change of anode volts}}{\text{change of grid volts}}$$

for the change of grid volts from 0 to -4 is plotted against anode resistance. This ratio is the voltage amplification of the combination of valve and resistance. It will be seen that an amplification of 15 is obtained with an anode resistance of 250,000 ohms and a grid bias of -2 volt, and that an input grid swing of at least 4 volts and an output swing of 60 volts can be dealt with with negligible distortion.

There is little point in increasing the resistance beyond 250,000 ohms.

Fig. 4, which gives the corresponding curves for an R valve, shows that it is possible to use too high an anode resistance.

Fig. 5 gives the corresponding curve for the D.E.5 valve.

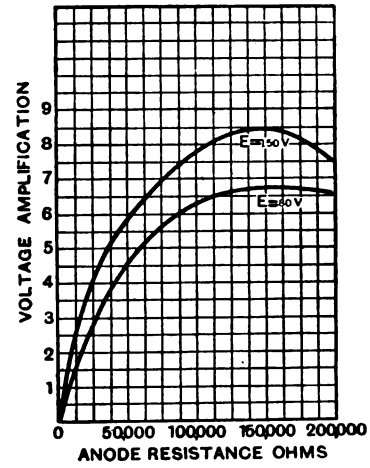

Fig. 4. The voltage amplification with an R valve and an H.T. voltage of 80 and 150.

Owing to the shunting effect of the coupling condenser and grid leak, amplifications of from 5 per cent. to 10 per cent. less than the values derived in the above way will be obtained in practice. It is interesting here to refer to the question of H.T. current economy.

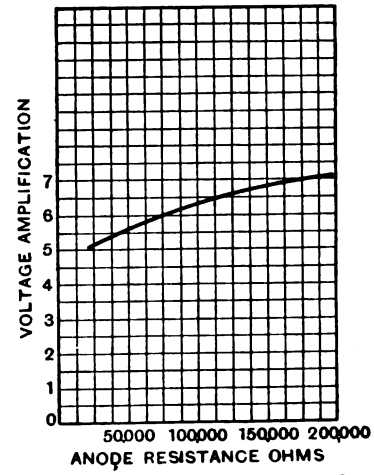

Fig. 5. The voltage amplification with a D.E.5 valve and an H.T. voltage of 150.

Two stages of distortionless amplification, giving a voltage amplification of about $14^2=196$ can be used with an increase of only about 0·6 mA. to the H.T. current.

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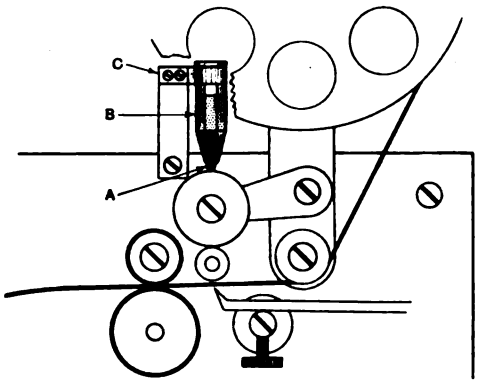
This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

An Inker Improvement.

MANY readers must have experienced the difficulty of obtaining a satisfactory ink supply on the inking wheel of a Morse recorder. The essential difficulty lies in obtaining a suitable quality of ink, but matters can be very much improved by fitting a small bracket which gives support to a glass tube into which the ink is introduced and is fed to the wheel by means of a small wick or brush.

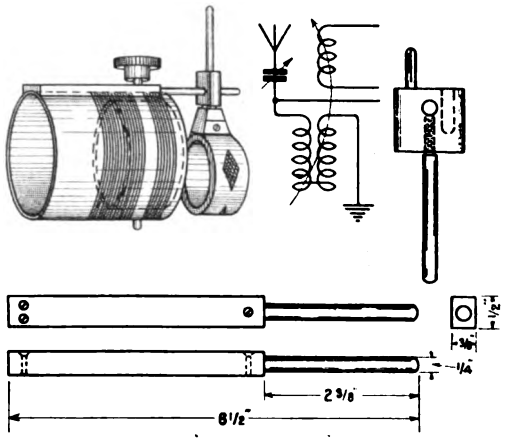
A. C. C.



Providing a continuous supply of ink on to the inking wheel of a Morse recorder. A = wick; B = glass tube; C = bracket.

Adding Reaction Coupling to a Variometer.

IT is not always easy to obtain reaction coupling when the aerial circuit is tuned by means of a variometer. A suggested method is shown which consists of fitting to the outer coil of the variometer an ebonite extension piece which passes through a hole made in a coil-holder. The coil-holder may be locked in position on the ebonite rod by screwing down the handle which is threaded into a tapped hole. Thus when a plug-in coil is carried in the coil-holder it can not only be moved so that the



Constructional details for fitting reaction coupling to a variometer.

distance from the aerial inductance increases but it can also be rotated to provide a very small degree of coupling, and at the same time critically controllable.

G. W. R.

Improving the Lead-in.

WHEN the aerial down lead drops vertically on to the leading-in insulator a path is provided for rain during wet weather, and a considerable quantity of water may be brought down on to the insulator, spoiling its insulating properties and rendering it dirty and corroded.

The insulator may be kept dry and the water run off by fitting a glass funnel as

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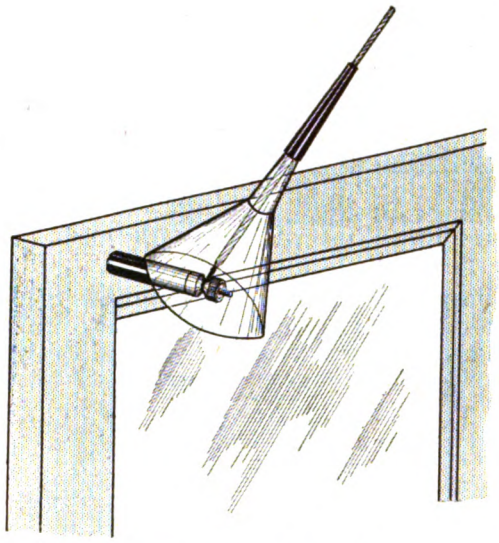
shown. A water-tight join is made with the down lead by means of a short piece of indiarubber tubing, while the rim of the funnel rests on the stem of the insulator.

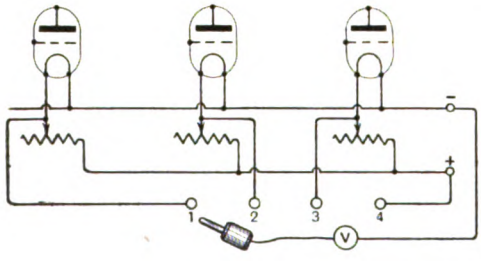
W. A. S.



Shielding the leading-in insulator.

Correct Filament Voltage.

USERS of multivalve receivers frequently find difficulty in obtaining the correct potentials across the filaments of all of the valves. By means of a wander plug and



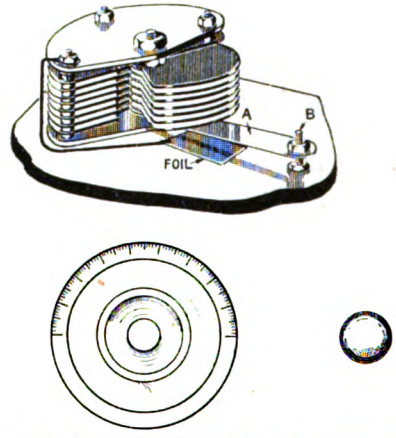
sockets or a switch of the rotary type a voltmeter can be applied across each of the filaments in turn and the best working potentials obtained.

A. C.

An Easily Fitted Vernier.

THE use of condensers fitted with a separately controlled plate to give vernier adjustment is not favoured by many experimenters, on account of the added space taken by a condenser so fitted and also in view of the increased cost.

A useful vernier can easily be added to the standard type by securing a small piece of metal foil to the face of the panel, and causing a strip of springy brass to approach it. The position of the brass strip is controlled by means of a 4 B.A. screw and is shown at B. A nut is soldered to the face



A fine adjustment can be obtained by employing this scheme.

of the plate so that as the screw is rotated the position of A changes with regard to the metal foil lying on the panel face. It will be found that a very critical control can be obtained in this way.

F. A. F.

Limiting Switch Arm Movement.

ONE of the easiest methods for preventing a switch arm from travelling over the end contact studs consists of drilling a small hole in the side of a stud and inserting a piece of hard brass wire. A contact stud fitted up in this manner is shown in the figure.

E. G. D.

A stud fitted with a stop.

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THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

A Super-Heterodyne Receiver with Three Stages of Transformer Coupled H.F. Amplification.

THE most popular coupling for the high frequency amplifier of a super-heterodyne receiver is the transformer. Transformers are favoured because it is thought that this form of intervalve coupling is cheaper than others. When tuned anode or resistance couplings are used, for instance, it is necessary to employ fixed condensers and grid leaks. These components add considerably to the cost of the amplifier. It is also usually thought easier to secure effective amplification when transformers are employed, and it is possible that in a poorly designed amplifier rectification may occur when grid condensers and leaks are used. However, with transformer couplings we have at least four variables—the number of turns in the primary, the number in the secondary, the gauge of wire employed and the distance between the windings. Each of these is important. If the ratio of the transformers is wrong; if too fine a wire is employed, or if the spacing of the windings is incorrect, amplification and selectivity suffer. But still, it *is* possible to make these values right and so to secure reasonably effective amplification and good selectivity.

The connections of a six-valve receiver having three stages of transformer coupled high frequency amplification are given in Fig. 1. Here we have a frame aerial tuned to the frequency of the incoming signal by condenser C_1 (0·0005 microfarads), which is connected to the first detector, V_2. A grid condenser and leak C_3 R_1 (0·00025 microfarad and 2 megohms) are employed for rectification and the grid return wire is joined to the positive side of the filament. In series with the frame aerial is the coupling coil L_1, which consists of a few turns of No. 20 D.C.C. coupled to the oscillator, V_1. The oscillator has a coil L_2 and tuning condenser C_2, which

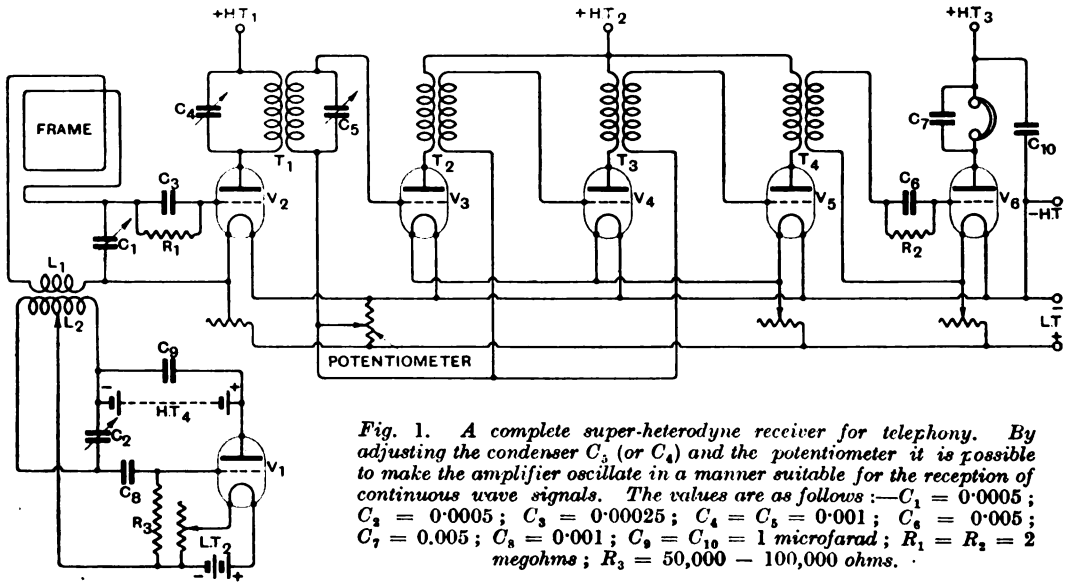

Fig. 1. A complete super-heterodyne receiver for telephony. By adjusting the condenser C_5 (or C_4) and the potentiometer it is possible to make the amplifier oscillate in a manner suitable for the reception of continuous wave signals. The values are as follows:—C_1 = 0·0005; C_2 = 0·0005; C_3 = 0·00025; C_4 = C_5 = 0·001; C_6 = 0·005; C_7 = 0.005; C_8 = 0·001; C_9 = C_{10} = 1 microfarad; R_1 = R_2 = 2 megohms; R_3 = 50,000 — 100,000 ohms.

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is tuned to a frequency differing from that of the incoming signal by the frequency of the high frequency amplifier. It should be noticed that one end of this circuit is connected through an H.T. battery to the anode of the valve, while the other end is connected to the grid through a grid condenser and leak C_8 R_3. The filament is connected to a tap on the coil. Usual values are C_2, 0·0005, C_8, 0·001, and C_9, 1·0 microfarad, and R_3, 50,000 to 100,000 ohms.

Between the first detector and the first valve of the H.F. amplifier is a tuned transformer T_1, having condensers C_4 and C_5, connected to the primary and secondary windings. These are drawn as though they are variable condensers in order to emphasise the fact that both windings of this transformer should be tuned. The desired result could, of course, be obtained by employing ordinary variable condensers, but this is not usually done—neither is it necessary. One must, however, adjust the values of these condensers, and the number of turns of the windings of this transformer in order to secure good selectivity. Usual values for the condensers are 0·001 microfarads when the transformer has similar windings. When the transformer has a turn ratio differing from unity, however, the values of the condensers must be adjusted accordingly. It will be remembered from the explanation given in earlier articles that the wavelength of the H.F. amplifier in the majority of instances lies between 3,000 and 10,000 metres. The coils of the first transformer T_1 may therefore have values corresponding to Nos. 300-750 Igranic coils.

Transformers T_2, T_3 and T_4 should be designed to have a natural wavelength equal to the wavelength of the first transformer. Sometimes tuning is effected by employing adjustable condensers across the secondary windings, but it is more usual to adjust the wavelength by removing turns from the coils. Whichever method is employed, it is quite essential to make the wavelength of each circuit as nearly alike as possible. The tuning of these transformers will, of course, depend a good deal on the capacity of the circuit—the capacity of the connecting wires and that of the valves. Hence it is important to make the adjustments with the transformer connected in the circuit and under operating conditions. It is by no means an easy job, and should not be undertaken too lightly, as the success or failure of the set depends in a large measure on this work being properly carried out.

The last valve, V_6, is the second detector,

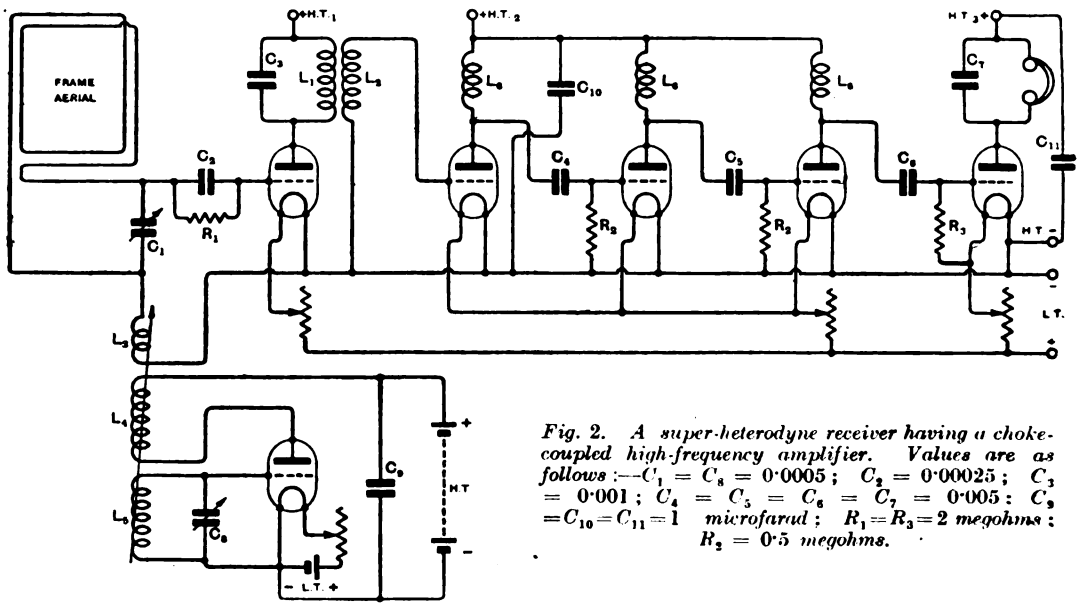

Fig. 2. A super-heterodyne receiver having a choke-coupled high-frequency amplifier. Values are as follows:—$C_1 = C_8 = 0{\cdot}0005$; $C_2 = 0{\cdot}00025$; $C_3 = 0{\cdot}001$; $C_4 = C_5 = C_6 = C_7 = 0{\cdot}005$; $C_9 = C_{10} = C_{11} = 1$ microfarad; $R_1 = R_3 = 2$ megohms; $R_2 = 0{\cdot}5$ megohms.

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having a grid condenser and leak C_6 R_2 (0·005 microfarads and 2 megohms) connected in the grid circuit with the grid return wire connected to the positive side of the filament. Transformers T_1, T_2 and T_3 have their grid return wires connected to a potentiometer, the function of which is to give one some control over the amount of amplification. Its use is neither recommended or condemned, because while I think it is perhaps the easiest method of controlling the amplifier, there are other more scientific and better methods of accomplishing this.

Adjusting the High-Frequency Amplifier.

The transformers employed in the high frequency amplifier may be adjusted to have a suitable wavelength by testing with a buzzer wavemeter. A suitable instrument is described elsewhere in these pages. It will be necessary to place the wavemeter some distance from the receiver when making adjustments if good results are to be obtained.

A Super-Heterodyne Receiver having Tuned-Anode Intervalve High Frequency Couplings.

A receiver having three stages of choke-coupled high frequency amplification is given in Fig. 2. The connections are similar to those of the resistance coupled set given on page 554 of January 21st issue, but chokes are employed in place of the resistances. Values of the components are given in the caption to the figure.

LOW-FREQUENCY REACTION.

The author found that when a loud speaker is placed in certain positions relative to the amplifier, howling is caused. He discusses this phenomenon and gives a remedy.

By G. H. WATSON.

WHEN testing an amplifier connected as in Fig. 1 for use with a microphone, reaction difficulties were encountered, which produced a howl whenever the loud speaker was used.

It was evident that the feed back was from the loud speaker to the microphone. With the loud speaker in some positions no feed back was noticed even though the loud speaker was directed towards the microphone.

A variation in distance between the two gave positions where no reaction was obtained, and positions where it was maximum; this is roughly shown in Fig. 2.

The note was far from pure, but had a pitch of about 900, and on measuring the distance between successive maxima it was found that

$$\frac{\text{Velocity of sound waves}}{\text{Frequency of sound waves}} = \frac{1{,}100}{900} = 1{\cdot}22 \text{ ft.}$$

Several types of loud speaker were tried and very little difference was noticed, but

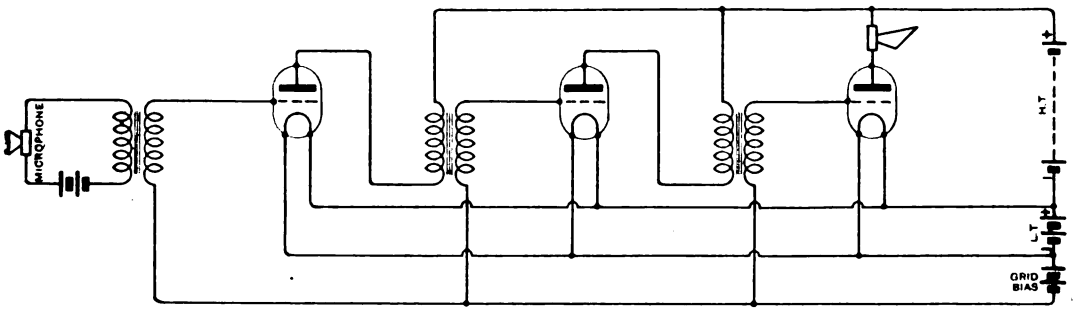

Fig. 1. An amplifier for strengthening the microphone currents.

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by altering the tension on the microphone diaphragm, the note altered and also the distance between successive maxima on the strength-distance curve.

The foregoing combination affords a fairly convenient means of measuring the frequency of sound waves, providing the natural frequency of the microphone can be accurately adjusted to the frequency of the sound it is desired to measure.

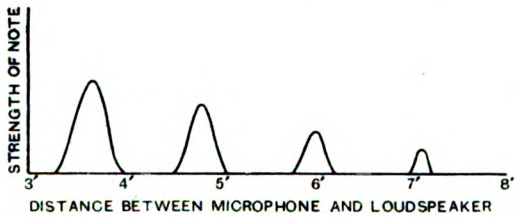

Fig. 2. Showing approximately the strength of the note set up with various distances between the microphone and loud speaker.

The spaces when near the microphone are due to the air waves swinging from 90 degs. to 270 degs. in opposite phase to the microphone diaphragm vibrations, as the loud speaker is moved back; when further from the microphone, reaction only becomes possible when absolutely in phase.

Dull emitting valves, when used with a loud speaker, often give trouble from mechanical resonance, which is a similar phenomenon to that mentioned above; the air vibrations produce vibrations of the valve, causing the electrodes to vary their distance relative to each other, which in turn alters the plate current at a frequency dependent upon the natural period of vibration of the electrodes.

As the note produced is usually of the order of 1500-2,000 cycles, giving an air wave of 8 to 6 inches, and the size of the valve is about 4 ins., it does not allow the placing of the loud speaker to produce anti-reaction as it does with the small microphone. Also, if several valves are used there might be anti-reaction on one valve and reaction on the others.

For this reason dull emitting valves for use with loud speakers should be enclosed in a case, and the lid closed whilst the set is in operation. This provision has been a satisfactory remedy for "mechanical resonance" in several sets which the writer has tested.

CALLS HEARD.

Walton-on-Thames, Surrey.
American: 1 AR, 1 BG, 1 BQ, 1 CG, 1 DA, 1 ER, 1 FP, 1 FG, 1 GV, 1 II, 1 KC, 1 ML, 1 MY, 1 PL, 1 RT, 1 SF, 1 SW, 1 XW, 1 XZ, 1 YO, 1 ZZ, 1 MX, 1 AW, 1 AAC, 1 AAU, 1 AHI, 1 AAL, 1 ABT, 1 AQW, 1 AOM, 1 AOU, 1 AUN, 1 ANA, 1 AJG, 1 BDT, 1 BDP, 1 BMT, 1 BQI, 1 BSI, 1 BSD, 1 BFN, 1 BGQ, 1 BVS, 1 BVS, 1 BKQ, 1 BIP, 1 BSD, 1 BIE, 1 BGO, 1 BKQ, 1 BSM, 1 BLE, 1 BGQ, 1 CAK, 1 CMP, 1 CKP, 1 CCQ, 1 XAM, 1 XAO, 2 BO, 2 BE, 2 BY, 2 CQ, 2 CV, 2 EM, 2 GK, 2 QH, 2 KU, 2 QW, 2 PD, 2 MU, 2 AFP, 2 ANA, 2 AWF, 2 ADJ, 2 APY, 2 BRC, 2 BGG, 2 BLM, 2 BRB, 2 BRD, 2 CVS, 2 CTV, 2 CYW, 2 CNK, 2 CPK, 3 HH, 3 GC, 3 BG, 3 WB, 3 HQ, 3 ZG, 3 HG, 3 OG, 3 KD, 3 ZD, 3 GK, 3 WR, 3 AU, 3 VW, 3 MB, 3 ADG, 3 ARI, 3 AJD 3 AUV, 3 BFE, 3 BCO, 3 BWT, 3 BOF, 3 BSS, 3 BTA, 3 BDO, 3 BFI, 3 CDN, 3 CDG, 4 EV, 4 OA, 4 XX, 4 FS, 4 ZD, 4 SA, 4 IO, 4 TJ, 4 RR, 4 XE, 5 UK, 5 RH, 5 KQ, 5 ZAS, 7 FR, 8 BF, 8 PL, 8 JQ, 8 KL, 8 SP, 8 UP, 8 XC, 8 BFE, 8 AMR, 8 CLN, 8 CYI, 8 CMI, 8 GHW, 8 DFW, 8 ALY, 8 CLN, 9 EM, 9 LD, 9 DXN, NKF NFU, LPX. French: 8 AQ, 8 CN, 8 EV, 8 EU, 8 FK, 8 FM, 8 FY, 8 GI, 8 GH, 8 LL, 8 LR, 8 MG, 8 PD, 8 UU, 8 WW, 8 WL, 8 ZP, 8 BRB, 8 LLM, 8 HSF, 8 HSM, 8 SSU, 8 SM, 8 AW, AIN. Australian: 2 ME, 2 CM, 3 BQ. Danish: 7 EC, 7 QF, 7 FR, 7 GQ. Italian: 1 AM 1, 3 AF. Finnish: 2 NM, 2 NCA, 3 NB. Swedish: SMYY, SMZS, SMZV, SMZZ. Luxembourg: 0 AA, 1 LW. Dutch: 0 II, 0 KN, 0 MS, 0 KW, 0 ZA. Others: P 2, 10 KZ, H 9 AB, POZ, 2 YT. (0—v—1.)
(F. Walker.)

Glasgow.
British: 2 DR, 2 DX, 2 CC, 2 FN, 2 FM, 2 KW, 2 YQ, 5 BH, 5 CX, 5 HC, 5 IK, 5 KT, 5 MA, 5 MO, 5 NN, 5 OX, 5 PD, 5 QV, 5 RZ, 5 SI, 5 SZ, 5 TZ, 5 UL, 5 XN, 6 FG, 6 GH, 6 GM, 6 LJ, 6 TM, 6 TD, 6 XJ, 6 YB. French: 8 AL, 8 BU, 8 BV, 8 CA, 8 CN, 8 CZ, 8 EN, 8 FI, 8 GH, 8 GI, 8 GM, 8 HSM, 8 LU, 8 PA, 8 QG, 8 QV, 8 SM, 8 UM, 8 UU, 8 UMZ, 8 ZI, 8 ZZ. Netherlands: 0 AX, 0 BA, 0 RA, 0 RE, 0 SK, 0 ZZ. Belgian: 4 CA, 4 UU, 4 YZ, B 7. Finnish: 1 FN, 2 NCA. Danish: 7 EC. American: 1 KC, 1 BCC, 1 XI, WGH. (0—v—0.)
(Geo. Spears.)

Tynemouth, Northumberland.
British: 2 AV, 2 CC, 2 DR, 2 DX, 2 FN, 2 GH, 2 GR, 2 GW, 2 HS, 2 IK, 2 IN, 2 IS, 2 KF, 2 KW, 2 KX, 2 NM, 2 OD, 2 PY, 2 SH, 2 TF, 2 TI, 2 UV, 2 VJ, 2 WD, 2 XD, 2 XY, 2 ZG, 5 AX, 5 BG, 5 BH, 5 BN, 5 BV, 5 CC, 5 CG, 5 CX, 5 DW, 5 IX, 5 FL, 5 GF, 5 HA, 5 ID, 5 IG, 5 IK, 5 JX, 5 KM, 5 LF, 5 LS, 5 MO, 5 NI, 5 NN, 5 OC, 5 OX, 5 RH, 5 RZ, 5 SZ, 5 TC, 6 AA, 6 AH, 6 AL, 6 BCD, 6 BY, 6 FG, 6 GH, 6 GM, 6 GS, 6 LJ, 6 ME, 6 NF, 6 SO, 6 TD, 6 TM, 6 XG. French: 8 AB, 8 ATC, 8 AU, 8 BA, 8 BF, 8 BP, 8 BV, 8 CA, 8 CK, 8 CN, 8 CT, 8 DA, 8 DI, 8 DP, 8 EN, 8 EU, 8 FK, 8 FM, 8 GER, 8 GI, 8 GO, 8 GP, 8 HAG, 8 LLO, 8 LO, 8 PA, 8 PP, 8 QG, 8 RBR, 8 RG, 8 RR, 8 SR, 8 SSU, 8 UL, 8 UU, 8 VV, 8 WZ, 8 XP, 8 XS, 8 ZUT, 8 ZZ. Belgian: P 1, P 2, 4 RS, 4 UU, 4 YZ, B 7. Swiss: 9 AD. Dutch: 0 BA, 0 RE, 0 ZZ. Luxembourg: 0 AA. Swedish: SMYY, SMZP, SMZV, SMZY. Italian: 1 FP, 1 DO. Danish: 7 EC. Finnish: FN 2 NCA, FN 2 NM. American: 1 SW. Unknown: FN 1, 1 JW, 1 NA, 3 CA, 3 CM, 3 ZV, 4 VV, 4 XA, 10 KZ, Y 20, YA 31, YA 35, UPA, WGH. (0—v—1.)
(H. F. M. Baker.)

Bolton, Lancs.
Australian: 3 BQ. American: 1 KC, 1 BHM, 9 BH, 1 ARE. French: 8 TM, 8 RM, 8 AB, 8 AQ, 8 DA, 8 BF, 8 DP, 8 EM. Belgian: 4 AA. Miscellaneous: 1 AM, 10 KZ, DJÄGA (?). British: 5 UQ, 2 OD, 5 KC, 2 NM, 6 KB.
(Gilbert N. Haslam.)

UNKNOWN CALLS.
LPX (heard at S. Farnborough, Hants).
QF8 (heard at Braintree, Essex).
"CQ Europe de DC" (heard at Cambridge).
GBZI (heard at Blackheath, London, S.E.3).

CALLS IDENTIFIED.
S 7 BD. Mr. F. Balsells, Cervantes 20-20-24, Reus (Varragona), Spain.
10 KZ.
Reports intended for 10 KZ may be forwarded c/o Monsieur R. Martin (F 8 DI), 63 Boulevard de la Republique, Nimes, France.

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SMALL ARC TELEPHONY APPARATUS.

It is surprising how few people realise that it is quite possible to use commercially systems of wireless telephony which do not employ valves. Yet, long before valves were introduced inventors had attempted to produce satisfactory apparatus. An example of a simple and satisfactory equipment is described below.

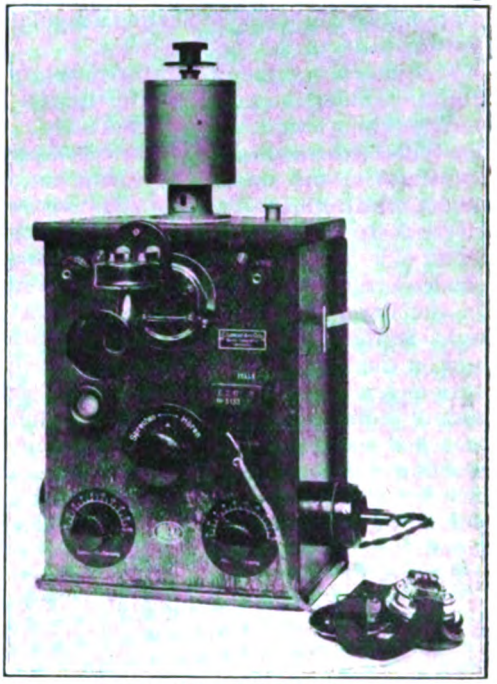

Fig. 1. A view of the Arc Telephony Transmitter and Receiver. Notice how few tuning controls are employed.

OWING to the development of the valve transmitter, very little interest is now taken in arc systems, especially on the part of amateurs. This is to be regretted, as the arc transmitter, with some slight disadvantages, has at least a few advantages as compared with the valve transmitter. The most important of these, at least so far as amateur work is concerned, is that he can if necessary make his own arc generator, without requiring any great skill to do so, whereas he cannot possibly make his own transmitter valves. The cost of maintenance or the cost of purchase of the accumulator and high tension battery is, moreover, not inconsiderable, while, with an arc transmitter these do not come into the question, as it is hardly any trouble, when a continuous current supply is available, to connect up the arc generator. A small choke coil suffices for the equalisation of the current supply variations, and it is quite unnecessary to use any complicated system of condensers, chokes, etc., as is the case when connecting up thermionic valves.

How simply and practically an arc telephony transmitter can be made is shown by a new design by the firm of C. Lorenz, of Berlin.

The apparatus, which is constructed for fixed wavelengths of between 600 and 800 metres, is of small dimensions and light weight, in consequence of which it can be used as a portable station. The adjustment of the apparatus is made by two knobs (one for transmitting and one for receiving), which affords the great advantage that any novice can operate it.

Fig. 1 shows a front view of the apparatus, which is contained in a wooden case 35 cms. high, 27 cms. wide and 18 cms. deep. To produce the high frequency oscillations a Poulsen generator with auxiliary circuit is used, which is situated on the top of the case in a brass cylinder. For receiving, a crystal detector is used. The tuning devices of the transmitter, in order to avoid multiplication of coils, are also used partly for receiving, the change from transmission to reception being effected by means of a special switch.

On the front panel of the apparatus, at the top left-hand side, is the connecting terminal for the aerial, on the right the terminal for earth, and in the middle the microphone. Under the aerial connection is placed the radiation indicator, in the form of a small glow-lamp bulb under a glass disc, as used in pocket lamps. On the other side, under the earth connection, can be seen the plug-in type crystal detector, and below this is the telephone socket. Under the microphone is the main switch, which is turned to the left for speaking and to the right for

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listening, and on the lower edge of the panel are the tuning adjustments for transmitting and receiving.

Sockets are provided on either side; that on the left is for direct circuit supply and that on the right is for connecting a regulating resistance.

The interior of the apparatus is shown in Fig. 2. Under the arc generator is seen the aerial tuning inductance, subdivided into six parts; beneath it is the microphone transformer, and under this again the coil across which the radiation indicating lamp is connected. The apparatus on the right-hand side of the case are the coils and condensers for the closed oscillatory circuit. In the lower part of the apparatus on the right is the aerial transmitting variometer and on the left, at the bottom, the receiving variometer, above which is a fixed value tuning condenser. The large instrument attached to the base is the iron-core reactance for the feed current. The main switch, which puts the antenna circuit into either the transmitting or the receiving circuit, is seen in the centre of the apparatus.

The operation of the apparatus is most simple. In transmitting, the main switch is put to "speaking" and the arc adjusted by turning the knob at the top of the set to a given setting. The aerial circuit is then tuned to the wavelength of the closed circuit as indicated by the lamp connected to the aerial circuit. When messages are to be received the main switch is put over to "listening," and the receiver tuned to the incoming telephony. Once the apparatus has been adjusted it is only necessary to put the switch to "speaking" or "listening" in accordance with the conversation.

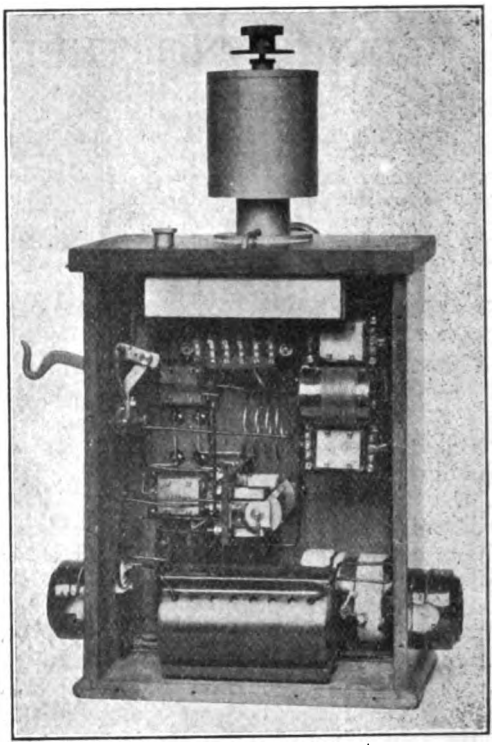

Fig. 2. A rear view of the set showing the arrangement of the apparatus.

ITALIAN NAVY'S SHORT WAVE TESTS.

A special series of tests on short wavelengths recently conducted between Italy and the South American coast, forms the subject of an interesting report we have received from the Italian amateur, Sgr. Adriano Ducati.

Sgr. Ducati was placed in charge of the wireless arrangements on board the "San Marco," the vessel which conveyed the Crown Prince of Italy on his tour to South America. An experimental wireless set was carried on the "San Marco," a similar set being installed at Rome, and a definite working schedule was arranged. Both sets employed A.C. at a potential of 250 volts.

On the outward journey the Rome Station, working on 108 metres, was heard distinctly as far as Buenos Aires in all weather conditions. This was in July, when the prevalence of atmospherics would have rendered signals on higher wavelengths unreadable. In spite of atmospherics, Rome continued to be heard until Bahia Blanca was reached.

Meanwhile, continued improvements were made in the transmitting equipment on the "San Marco," and Sgr. Ducati was able to communicate with the home station with equal facility. The antenna system was similar to that employed at ACD, Sgr. Ducati's station at Bologna, and an aerial ammeter reading of 18 amperes was obtained with an input of 1,000 watts, a wavelength of 99 metres being used. Signals were reported as very strong by a number of South American amateurs, and two-way communication was established with more than fifty American amateurs. The record transmission was achieved when a high speed message was copied by New Zealand 4 AA, using only two valves, and with neither aerial nor earth.

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PATENTS AND ABSTRACTS

The Use of Alternating Currents for Supplying Filament and Anode Current.

In ordinary methods of employing alternating currents for heating the filaments and supplying the anode circuit of a valve receiver, it is usual to rectify and smooth the alternating current applied to the anode circuit and to connect the filaments through a suitable transformer. In an arrangement of this kind the anode current varies if precautions are not taken. These variations have the same frequency as the alternating current and are due to the variation of the temperature of the filaments, and of the anode current. They constitute a disturbance which seriously interferes with reception.

In order to eliminate this disturbance, an auxiliary alternating current of suitable magnitude and phase may be included in the anode-filament circuit. The diagram of Fig. 1 shows one method of securing the desired results.

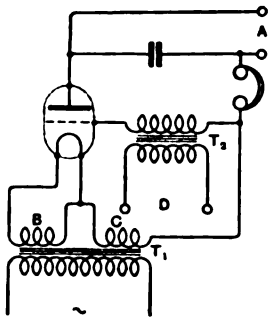

Fig. 1. Showing the connections of a compensating winding C to reduce noise.

The valve is heated from the winding B of a step-down transformer T_1 and the anode circuit is supplied with a rectified and smoothed current at the terminals A. In the grid circuit is connected an ordinary intervalve transformer T_2 which has its terminals D connected to the output terminals of a receiver, and telephones are connected in the usual manner in the anode circuit. According to the invention for

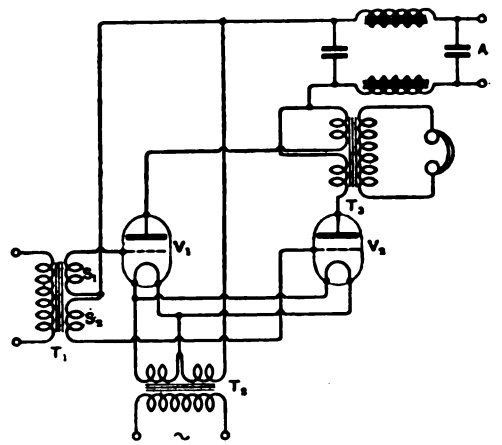

Fig. 2. The connections of a push-pull receiver for working off A.C.

eliminating noise (described in British Patent No. 205,472), the transformer T_1 has a third winding C. This winding is mounted between one side of the filament and the intervalve transformer in the grid circuit, and provides a compensating current which reduces the noise. The buzz produced by the variations of filament temperature due to the use of alternating current is, however, not entirely prevented, but an arrangement of valves as in Fig. 2 may be employed which has the desired effect of practically eliminating all noise. The currents to be amplified are passed through the primary winding T_1 and influence the grids of valves V_1 and V_2 through the secondaries S_1 S_2, and a transformer T_3 having a split primary winding is connected between the anodes of the valves and the telephones as in push-pull receivers.

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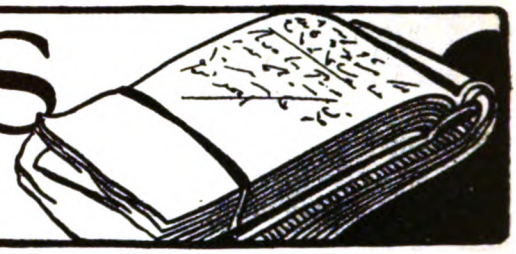
NOTES & NEWS



An amateur wireless boom is reported to have started in Egypt.

* * * *

Nearly 31,000 receiving licences are stated to have been issued in Sweden up to the end of 1924.

* * * *

More than fifty firms are represented at the *Leeds Mercury* Wireless Exhibition, which remains open until the end of this week.

* * * *

Norway has suffered badly in the recent gales. Most of the telegraph and telephone wires to the North have broken down, and wireless is being used almost exclusively.

* * * *

In Sheffield 22 per thousand of the population are reported to have taken out wireless reception licences. In Bournemouth the proportion is 120 per thousand.

* * * *

Senatore Marconi has been elected an honorary member of the Institution of Civil Engineers.

* * * *

DAYLIGHT TRANSMISSION ON TWENTY-ONE METRES.

An indication that daylight conditions do not affect short wave signals to the same extent as those on the higher wavelengths is afforded by the experience of Mr. J. H. Reinartz, the American amateur and circuit designer, who has succeeded in transmitting signals across the American continent in broad daylight on a wavelength of only twenty-one metres. Transmitting from South Manchester, Conn., Mr. Reinartz received reports of his signals from amateurs at Berkeley, California; Hartley, Iowa; and Winter Park, Florida.

RADIO PARIS RELAYS 5 XX.

On several recent occasions the Radio Paris broadcasting station has relayed the programmes from the Chelmsford station for the benefit of French listeners. Radio Paris operates on 1,780 metres and relay transmissions are carried out after 10 p.m., at the conclusion of the station's ordinary programme.

SPANISH DX RESTRICTION.

Amateur radio transmitters in Spain are suffering under a severe handicap in their relations with experimenters of other countries, it having been decreed, states a correspondent, that no Spanish amateur may use the wave band between 120 metres and zero. This legislation has had no effect, however, on the number of amateurs applying for transmitting licences, which are being issued in many of the towns. Spanish amateur transmitters, who pay an annual licence fee of 200 pesetas, are allowed a maximum power of 100 watts.

A CZECHO-SLOVAKIAN AMATEUR.

It is now definitely ascertained that the call sign CS OK1, reception of which has been reported by a number of readers, is that of an amateur at Prague, Czecho-Slovakia, who transmits on 95 metres.

Two-way communication has been established with CS OK1 by Mr. J. W. Riddiough (G 5 SZ), of Morecambe.

SUNSHINE RECEPTION OF AMERICAN AMATEURS.

The extent to which American amateurs can be heard in this country, even in bright sunshine, within the period of a few minutes, is shown by the experience of Mr. E. J. Simmonds (2 OD) on a recent Sunday, between 9.45 and 10.7 a.m. (G.M.T.). In the space of 22 minutes the following were picked up:—1 CI, 1 ER, 1 SN, 1 ZT, 1 PL, 1 ML, 2 BRB, 2 MU, 2 AAR, 3 OT, 4 KL, 8 APL, 8 BSI, 8 DHW, 8 MC.

All the above stations were received well. Many more could have been logged, states Mr. Simmonds, but American Morse is very indifferent, and much time is lost by long CQ calls!

ABERDEEN ENTERTAINS BOMBAY.

Astonishing reception of the B.B.C. programmes is reported by a Bombay reader, who states that his neighbours, on the other side of the street, enjoy listening to Aberdeen on his loud speaker, clapping and joining in with the singing.

Chelmsford and London are received almost nightly on a six-valve set (3—v—2).

A PROFITABLE ANNOUNCEMENT.

There are enterprises less profitable than running a "one man" broadcasting station. According to a message from Mattapoisett, Massachusetts, Mr. Irving Vermilya, operator of the "one man" broadcasting station WBBG, recently announced

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that he was a pipe smoker and enjoyed a particular brand of tobacco. Up to the present the number of cans of tobacco received is 137.

Mr. Vermilya is the New England Division Manager of the American Radio Relay League.

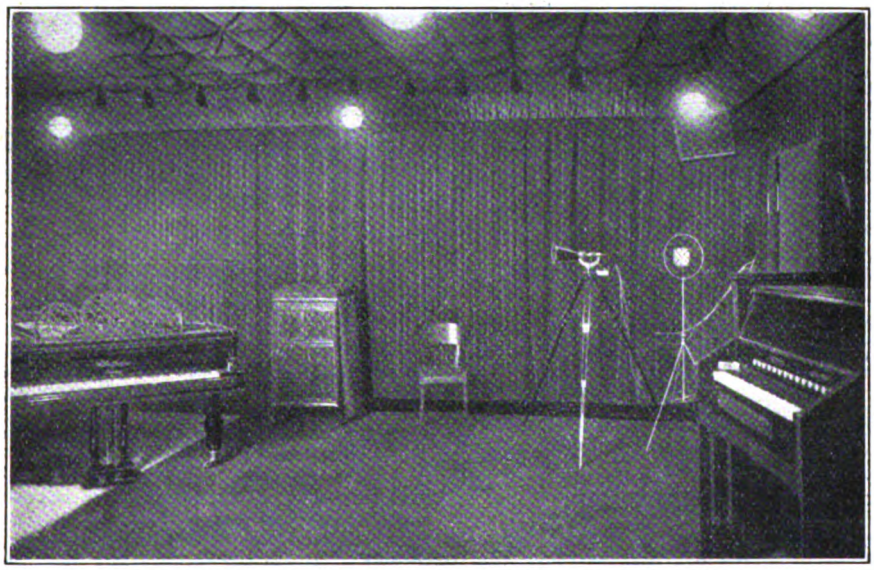
GERMAN PUBLIC AND WIRELESS TECHNIQUE.

There is no sign of any falling off in the public interest in broadcasting in Germany, says a Berlin message. The number of new listeners-in registered with the postal authorities has recently averaged 80,000 daily. One Berlin paper remarks that the number of home-built sets is not so great as in certain other countries, since "the technical knowledge of the general public in Germany does not compare well with that of the general public in England and America."

Arts, to be held in Paris this year. The organisers of the exhibition, realising that wireless has a claim to be considered along with arts and handicrafts, have conceded space to the Syndicat Professionel des Industries Radioélectrique. The selection of radio exhibits, which will be confined to the finest products of the designers' and cabinet makers' art, will have to meet the approval of a special jury before they may be displayed.

CHILI SIGNALS RECEIVED IN DAYLIGHT.

Probably the first British amateur to pick up Chilian signals in daylight is Mr. T. A. Studley, of Harrow, who has received written confirmation of his log from Mr. R. Raven-Hart (9 TC) of Los Andes, Chili. 9 TC's signals were received by Mr. Studley at 7.30 a.m., on November 23rd last, on a



Many of our readers will be interested in the above picture of the studio of the Leipzig Broadcasting station. This station can easily be heard in this country and operates on a wavelength of 454 metres.

JOURNAL DES 8.

Among the many amateurs who take an interest in the "Calls Heard" section of this journal, there may be some who are unacquainted with the *Journal des* 8, an enterprising little weekly published in France, with the object of linking up the activities of French transmitters and their *confrères* in other countries. The *Journal des* 8 contains, in addition to notes on amateur installations, specially prepared lists of "Calls Heard," in which a number of British calls are to be found. It is published at the Imprimerie Veuclin, Rugles, Eure, France, the annual subscription rate being 35 francs.

WIRELESS AND ART.

The artistic side of wireless instrument design is to have a place at the Exposition of Decorative

single valve receiver, when the Chilian was working on 90 metres with a power of 500 watts. Mr. Raven-Hart is continuing transmissions under these conditions and would be glad to receive reports addressed to him at 9 TC, Los Andes, Chili.

BROADCAST PLAY DIFFICULTIES.

It would appear that there is little demand for the broadcasting of long plays. Following the performance of "The Tempest," at 2 LO on Friday, January 16th, the B.B.C. received reports from all parts of the country showing that difficulty was experienced in identifying the numerous characters. General opinion is in favour of plays not exceeding the twenty minute mark, and with fewer characters than are usually to be found in Shakespearian drama.

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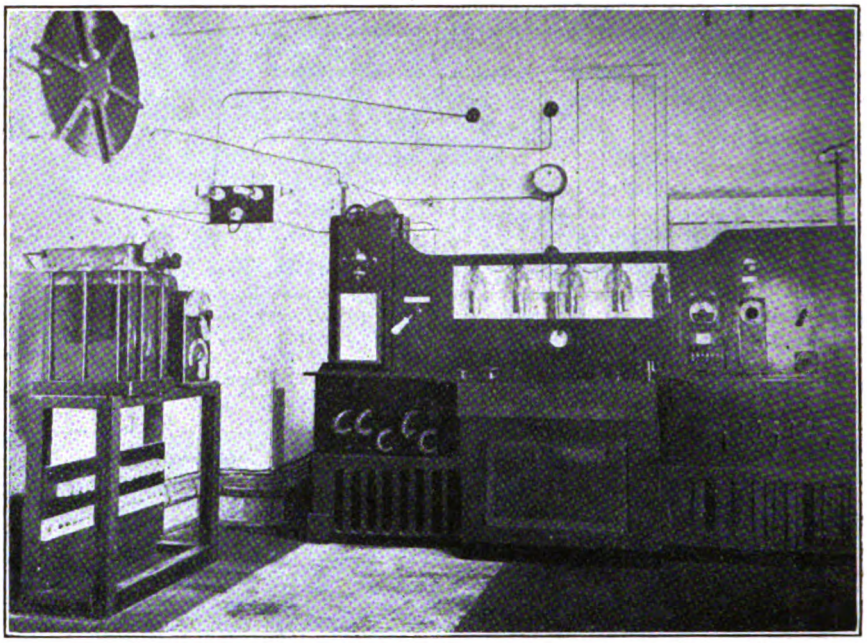

A view in the Control Room at the Koenigswusterhausen broadcasting station.

LONG AND SHORT WAVE CALIBRATION TESTS.

During February an important series of calibrated signals will be transmitted from WWV, the station of the U.S. Bureau of Standards at Washington, D.C., and from 6 XBM, the Stamford University, California. We are indebted to Mr. J. Gordon Ritchie, of Glasgow, for the following schedule of these transmissions. The times given are Eastern Standard Time for WWV, and Pacific Standard Time for 6 XBM, the former being 5 hours and the latter 8 hours slow on Greenwich time.

	Feb. 5th.	*Feb. 20th.*
	Metres.	Metres.
10.00 to 10.8 p.m. ..	100	2,400
10.12 to 10.20 p.m. ..	91	2,254
10.24 to 10.32 p.m. ..	83	2,097
10.36 to 10.44 p.m. ..	75	1,934
10.48 to 10.56 p.m. ..	68	1,800
11.0 to 11.8 p.m. ..	61	1,463
11.12 to 11.20 p.m. ..	55	1,153
11.24 to 11.32 p.m. ..	50	952

The signals will be transmitted by unmodulated C.W. Each transmission will consist of a "general call" (2 minutes), a "standard frequency signal" (a series of very long dashes with the call sign intervening, lasting about 4 minutes) and "announcements" giving the measured frequency and particulars of the next frequency to be transmitted.

These signals are intended to be heard 1,000 miles from each station, but it is quite probable that they may be picked up in this country.

CORRESPONDENCE.

Regulations and the Experimenter.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Might an old and enthusiastic reader venture to join issue for a few words with the somewhat retrograde tendency in to-day's Editorial. One gathers that *Wireless World and Radio Review* views with regret the disappearance of the experimenter as a privileged class and holding a privileged licence. Who were these people? Was their knowledge so terrific that the rest of us gasped with amazement.? I believe they could read twenty words of Morse per minute but most of us know cases where even this qualification would prove wobbly on test.

To prohibit the use of reaction is surely secondary to prohibiting the outdoor aerial. The latter remedy has been rarely suggested but is surely more on the lines of progress. The writer has logged several American stations on a short indoor aerial in his flat, and is prepared to venture that no interference to others was caused during the process. The crystal user could still have his outside wire under any such scheme. Above all else, sir, do not let us traffic with monopoly or privilege in wireless.

Regulations are, of course, a necessity and a right of the citizen, but let such regulations stimulate research and not destroy it. The vast majority of your readers are probably more interested in research than inferior concerts and probably the vast majority would lack those mysterious qualifications necessary in order to obtain the "Experimental licence." It is time the rights of these people were pretty forcibly expressed.

West Kensington. G. C. P. BRAUN.

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Radio Society of Great Britain.

The Society's ordinary general meeting, held on Wednesday, January 21st, was marked by the retirement of Dr. W. H. Eccles, M.I.E.E., from the Presidency of the Society, and the accession to that post of Sir Oliver Lodge, F.R.S.

In his final speech as President, Dr. Eccles said there was no need to spend much time in introducing Sir Oliver Lodge to any wireless audience in the world, and particularly in the case of an audience of British experimenters. If we traced wireless back to the discovery of electric waves in 1887 we should find from the records that Lodge was actually demonstrating their existence at the moment when Hertz announced the results of his own famous researches.

Having spoken of the early work of Sir Oliver Lodge, Dr. Eccles remarked that he considered it of special interest to the members of the Society that Dr. Lodge, as he then was, was not a professional inventor. He was, in the true sense of the word, an amateur.

"We may say," said Dr. Eccles, "that Lodge was the first wireless amateur, just as we may say that our only other honorary member, Marconi, was the first wireless engineer. Therefore, at this present time, when the amateur has attracted universal attention by his contributions to wireless science, it is especially appropriate that we should have as our President the earliest and the greatest of all radio experimenters."

Sir Oliver Lodge, replying, said that it was not only an honour, but a great pleasure and privilege to succeed in the Chair a man like Dr. Eccles, and in the penultimate chair a man like Sir Henry Jackson.

"You see before you," he said, "what may be called 'hymns' ancient and modern. (loud laughter). I and Sir Henry Jackson are the ancients. Eccles and a good many others here are the moderns and you will not expect me to give my view or to give any notion of the most recent advances and the constant inventions which are flowing from the amateurs of this country as well as from the professionals; the amateurs are doing a great work and the amount of 'experimenting' that goes on is something tremendous, so that really ten years hence the science will have again advanced as it has advanced up to now. I must say that I am grateful for what Eccles has said. He knows a lot about it because he has been engaged in patent cases where these things really crop up and he has gone into it very thoroughly. I was in at the beginning, because I go back to the time of Clerk Maxwell, whose great treatise was published in 1873, and in 1875 I spent the whole of the summer studying it. His theory of electromagnetic waves excited my wild enthusiasm at the time. It was all mathematics in those days. Nobody knew how to produce electromagnetic waves or how to detect them. It is wonderful now to look back at those times of darkness; we knew nothing but mathematics. Then about the same time as Dr. Eccles has said, Hertz and I found them together; but Hertz found them much more thoroughly and more satisfactorily and they are truly Hertzian waves based upon Clerk Maxwell's researches a quarter of a century before. We found how to produce them and how to detect them in an infantile manner and so it went on until Marconi came and put the matter on a substantial commercial, financial and Governmental and telegraphic basis. Then things began to hum and here we are. (Laughter). Of course, Fleming and other workers have chipped in with the valve and it is astonishing now what can be done. We used to deal with only Morse signals; I did not think that wireless telephony would be possible. Now it is easy. I knew that short waves were more powerful in many respects than long ones but I did not think that any waves could go round the earth. I am told now that amateurs can get to New Zealand by wireless waves of short wavelength, the only wavelength they are allowed.

Conductors are full of loose electrons. A copper wire is a crowd of loose electrons in elongated form. When you want to reflect waves, you use a copper sheet, a good conducting sheet; the loose electrons do it. Eccles and Heaviside have shown that in the atmosphere under the rays of the sun, there is a crowd of loose electrons—ions—which arrange themselves nicely at night and form a sort of copper dome over the earth; and thus you get the waves to go round. It is amazing, a kind of thing we could not have expected but which enables the waves to go to these enormous distances without much loss instead of going off into space and doing nothing, or at least very little."

Sir Oliver Lodge then proceeded to deliver his Presidential address on "Matter and Radiation," a full report of which will appear in a subsequent issue of this journal.

T. & R. NOTES.

The principal item of interest during the past fortnight has been G 2 NM's two-way working with SA WJS, the 100-watt wireless station at the base camp of the Rice expedition, which is exploring the Amazon River Hinterland of Brazil. The signals from this remote outpost came in at extraordinary strength on two valves, the more remarkable when it is considered that the power plant could only have been local, such as a petrol-driven alternator. SA WJS reported that he had also been in communication with NZ 2 AP, in addition to all the American districts, except the 7th.

Another commendable performance is the reception, by Mr. Galpin (5 NF), of American 8 XG on 45 metres. This interesting feat took place at 10.30 p.m. (G.M.T.) on January 17th.

Members are again reminded of the International Conference of Radio Amateurs in Paris, from Thursday, April 16th, until Monday, April 20th, in connection with which Mr. Gerald Marcuse (2 NM) is prepared to arrange for special accommodation and travelling facilities. Enquiries should be addressed without delay to Mr. Marcuse, c/o The Radio Society of Great Britain, 53 Victoria Street, London, S.W.1.

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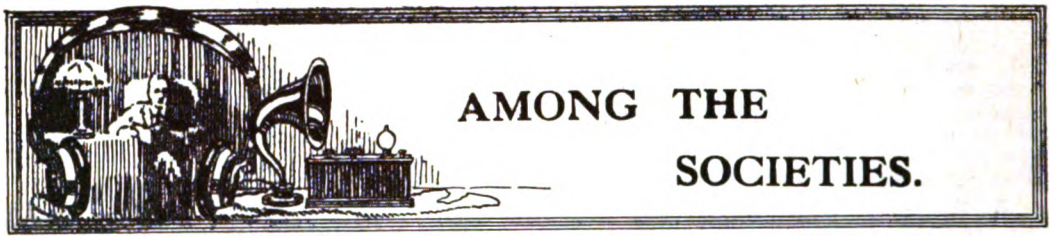

Radio Society of Great Britain.

Many of the difficulties encountered in short wave work were elucidated by Mr. Stanley Ward in the course of his informal talk before the Radio Society of Great Britain on January 14th.

One of the pressing needs of to-day, said Mr. Ward, is a condenser of sufficient mechanical soundness for the delicate adjustments necessary in short wave work. The speaker produced an interesting model of his own design, embodying a cone bearing which entirely eliminated side play, and at the same time ensured equidistant spacing of the plates.

Mr. Ward's "straight" circuit with which he had been able to tune down to 40 metres, aroused considerable interest. The circuit employed an aperiodic aerial, tuning being accomplished on the closed circuit. The use of a low capacity H.F. valve was strongly recommended, together with a potentiometer in preference to the condenser and grid leak method. A useful feature was the inclusion of an inductive resistance in the anode circuit; this permitted the insertion of telephones in such a way that they could be handled without upsetting tuning.

In the ensuing discussion Mr. G. G. Blake referred to noises in grid leaks, and outlined a method evolved several years ago, of constructing a grid leak of moist cotton, an arrangement which satisfactorily overcame the trouble. Mr. Alford, whilst preferring the superheterodyne for short wave work, admitted that excellent results could be secured with a "straight" circuit provided that meticulous care was taken in the construction and handling of the receiver. Captain Ainslie (occupying the chair), described an interesting single valve "straight" circuit, which enabled him to listen to KDKA on the 60-metre wavelength, while Mr. Robinson contributed a warning regarding the disadvantages of placing the short-wave receiver in the vicinity of metal objects which might easily be in resonance with the set. With high frequency circuits, a metal object 6 feet away might conceivably be "tightly coupled."

A demonstration of how to work a wireless set under difficulties was given by Mr. B. A. Matthews at the Birmingham Experimental Wireless Club on January 9th, and aroused considerable interest. Following the demonstration, the Club's nearly completed set was examined and formed the basis of a profitable discussion.

A five-valve set embodying a number of nove features was exhibited by its constructor, Mr. Toye, before the Hackney and District Radio Society on January 12th. All connections in the set are made with small plugs and jacks, and although any combination of valves can be used, no switches are employed. Mr. Toye demonstrated the ease with which changes could be made by this unusual method.

* * * *

For reasons of ill health, Mr. J. W. Pallett, Hon. Secretary of the Leicestershire Radio and Scientific Society, has been obliged to relinquish his post. All correspondence should therefore, be addressed to the new Hon. Secretary, Mr. A. E. Walker, Glen Burn, Ashleigh Road, Leicester.

FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 28th.

Clapham Park Wireless and Scientific Society. At 7.45 p.m. At 67 Balham High Road. Lecture by representative of the Gramophone Co., Ltd.

Radio Research Society of Peckham. Lecture: "Condensers—Their Action and Importance." Demonstration: "Stunts."

Streatham Radio Society. Lecture: "Infra Red Rays." By Mr. Roddis

THURSDAY, JANUARY 29th.

Bournemouth and District Radio and Electrical Society. At the Y.M.C.A., St. Peter's Road. Lecture: "Esperanto and its Relationship to Radio Work."

Luton Wireless Society. At 8 p.m. At the Hitchin Road Boys' School. Experiment and Demonstration for Beginners.

FRIDAY, JANUARY 30th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Department of Applied Science, St. George's Square. Lecture: "Esperanto as a Radio Language." By Mr. John Merchant.

Radio Experimental Society of Manchester. Illustrated Lecture: "My Wireless Life in West Africa." By Dr. L. S. Palmer, Ph.D.

MONDAY, FEBRUARY 2nd.

Dorking and District Radio Society. At 65 South Street. Members' Evening with Apparatus.

CATALOGUES, ETC., RECEIVED.

Falk, Stadelmann & Co., Ltd. (83, 85 and 87 Farringdon Road, London, E.C.1). Catalogue No. 522, containing full particulars of Efescaphone Wireless Receiving Sets and Components. Copies on receipt of postage.

Morch Bros. (35 Tresham Avenue, London, E.9). Illustrated catalogue of Rex Products, including Valve Receivers and Amplifiers.

M-L Magneto Syndicate, Ltd. (Victoria Works, Coventry). Particulars of the M-L Anode Converter with price list.

Leslie Dixon & Co. (9 Colonial Avenue, Minories, E.1). Electradix Catalogue of everything Electrical.

A. F. Bulgin & Co. (9, 10 and 11 Cursitor Street, London, E.C.4). Catalogue of Aermonic Radio Requisites.

Fuller's United Electric Works (Woodland Works, Chadwell Heath, Essex). List No. 325, describing the "Little Sparta" Loud Speaker.

Watmel Wireless Co. (332A Goswell Road, E.C.1). New "Watmel" Show Card, available to traders.

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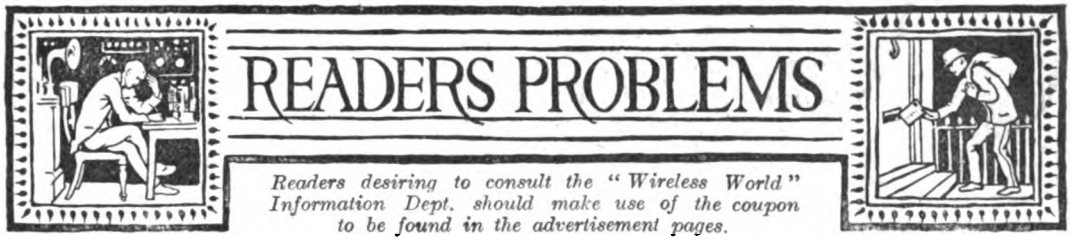
READERS PROBLEMS
Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

A SELECTIVE THREE-VALVE CIRCUIT.

A CORRESPONDENT has written asking if we can recommend a reliable three-valve circuit capable of receiving most of the main B.B.C. and continental stations under favourable conditions. As the set is to be used within 20 miles of one of the main stations selectivity is an essential point. Our correspondent also desires to dispense with low frequency amplification.

As great sensitivity is demanded of the set it is essential that one or more stages of high frequency amplification be employed. With regard to selectivity, probably the best method of accomplishing this is by the use of loose coupling, but, unfortunately, this is productive of instability when used in conjunction with high frequency amplification. It is necessary, therefore, to find some means of stabilising the circuit. The use of a potentiometer or similar means of introducing losses by damping into the high frequency circuits is not altogether to be recommended from the point of view of efficiency. We have therefore incorporated the neutrodyne method of compensating for the capacities between the elements of the valve and the wiring of the circuit. Once these capacities have been successfully neutralised by means of the small condensers provided, this adjustment can remain untouched provided that valves or coils remain unchanged. For the band of wavelengths occupied by the B.B.C. and the majority of the continental stations the primaries of the H.F. transformers can consist of about 24 turns of No. 24 D.C.C. wire wound in the form of a basket coil on a former 1½ ins. in diameter. The secondaries can consist of 66 turns of the same wire on a former of the same dimensions. The tapping for the neutralising condenser should be made in the centre of the secondary coil. It is important that the coils be wound in the same direction. The primary, secondary and reaction coils can, of course, be plug-in coils of the usual values for these wavelengths. For operating a loud speaker any two-valve L.F. amplifier of good design may be used.

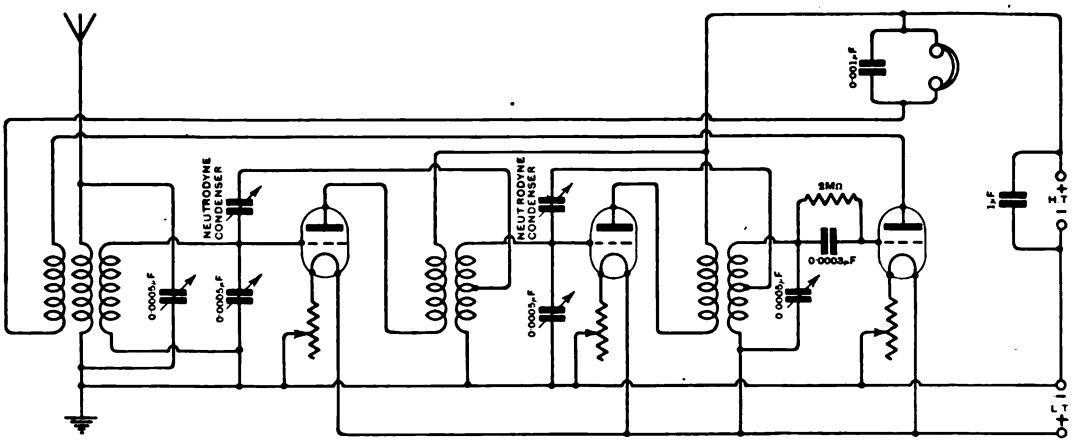

Fig. 1. A sensitive and selective receiver with two stages of transformer-coupled H.F. and valve detector with reaction coupled to the aerial.

INSTABILITY IN A FOUR-VALVE RECEIVER.

A READER has submitted a diagram of his four-valve receiver, and asks us to suggest a possible cause of the extreme instability of the instrument, it being prone to burst into oscillation at the slightest provocation, even when the potentiometer controlling the grid of the H.F. valve is over to the positive side.

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The receiver is of the conventional type employing one H.F. valve, detector, and two L.F. valves. In a receiver of this type it is unusual to find instability, the set being perfectly stable without a potentiometer provided the set is carefully operated. In this particular receiver, however, we notice that although only one H.F. stage is employed, it contains no less than five D.P.D.T. switches in the high frequency portions of the circuit. These are for placing the A.T.C. in series or parallel, cutting out the H.F. valve, and reversing the reaction coil, but in addition to these there are two switches for the purpose of using tuned anode, tuned transformer or resistance coupling for the H.F. stage. Our correspondent informs us that all these switches are of the miniature nickel plated type.

From this information it is not difficult to perceive the cause of the instability concerning which our correspondent complains. It is quite a common mistake among home constructors to think that a large number of switches can be placed in the H.F. circuits with impunity. This applies specially to those of the miniature type which necessitate the connecting wires running in close proximity. It would be well to eliminate as many switches as possible, and to replace the remaining ones by those of the anti-capacity type. The two intervalve coupling switches can be eliminated by bringing the requisite connections to four valve sockets of the anti-capacity type, and constructing plug-in units for the various forms of coupling. For obtaining the utmost efficiency from a set employing H.F. amplification in any form, no switches whatsoever should be incorporated with the high frequency portions of the set.

An L.F. Amplifier with Alternative Choke or Resistance Coupling.

In response to requests from readers we illustrate below a circuit for a two-valve L.F. amplifier with alternative choke or resistance coupling. The H.T. voltages suitable for both methods of coupling are adjusted to the correct value, and when changing over from one method of coupling to the other the correct H.T. voltage is simultaneously adjusted according to the needs of the particular method of coupling employed. A switch is also provided for cutting out one stage if desired. The usual adjustable grid biasing battery is also included in the diagram.

This circuit is very suitable for making a rapid change over from one system of coupling to the other in order to compare the quality of reproduction and volume peculiar to each system. The values for anode resistances, grid condensers and leaks which we give are good average values for obtaining high quality reproduction. The chokes may have a value of 100 henries, and can consist of the primary and secondary of an intervalve transformer connected in series. A valve having a high amplification factor may be used in the first stage if desired, but it is recommended that the final valve be of the power type.

It is important to connect the input terminals of the amplifier in the correct manner to the telephone terminals of the valve receiver. The same L.T. battery can be used for the receiver and amplifier, but a separate H.T. battery is advisable.

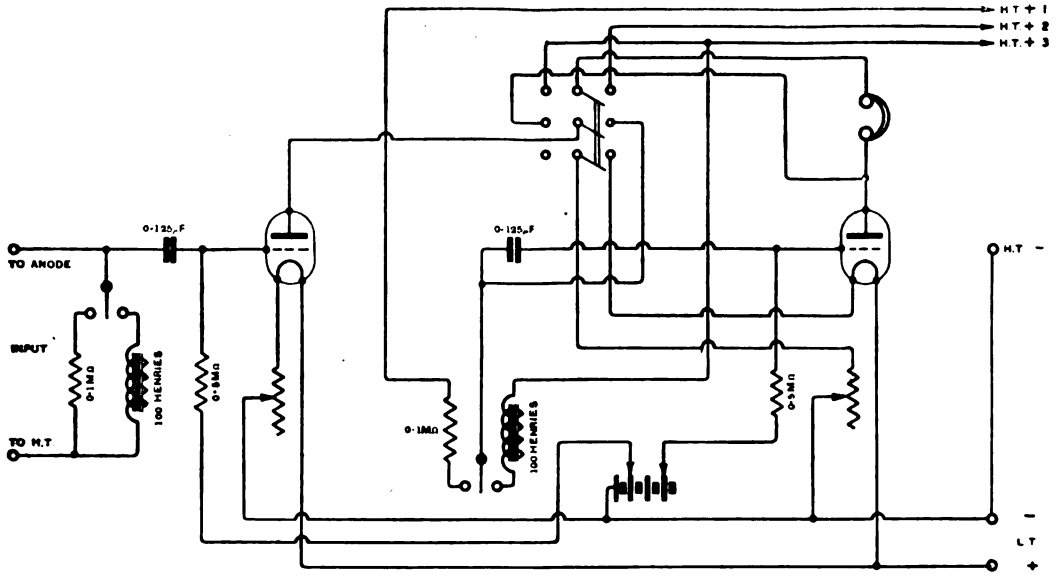

Fig. 2. An L.F. amplifier arranged for resistance or choke coupling.

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Experimental work demands reliable component parts. If your condensers and resistances are apt to vary in value during a test, hours of patient research may be wasted.

The moral is obvious ; see that each and every component used in your circuits can be relied upon to the full.

As far as condensers and resistances are concerned this is a simple injunction ; you have only to see that they bear the name of Dubilier.

There is a wide range of Dubilier Products for you to choose from, and we shall always be pleased to quote for any condensers, etc., required for special duties.

E.P.S. 125

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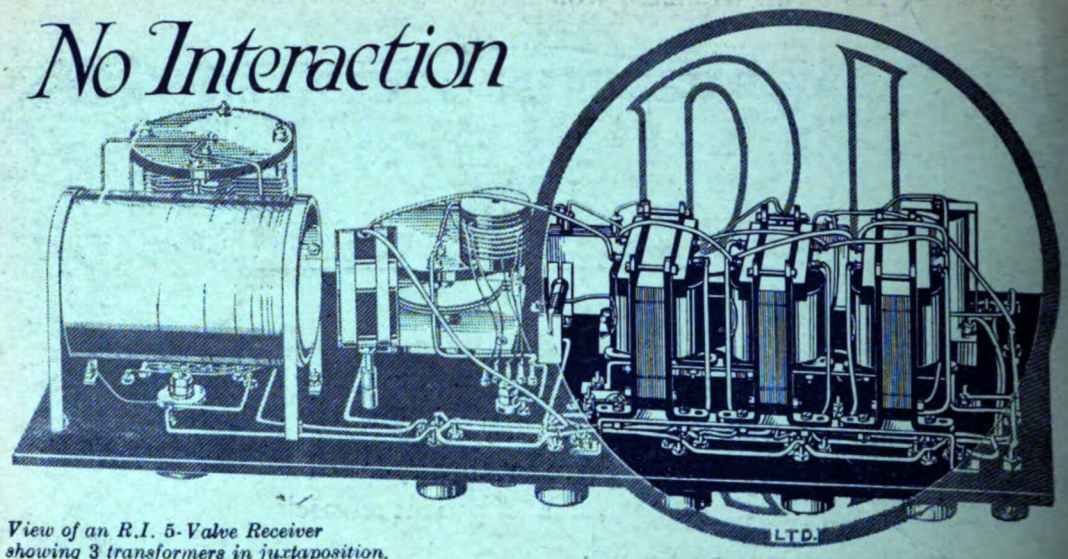
No Interaction



View of an R.I. 5-Valve Receiver showing 3 transformers in juxtaposition.

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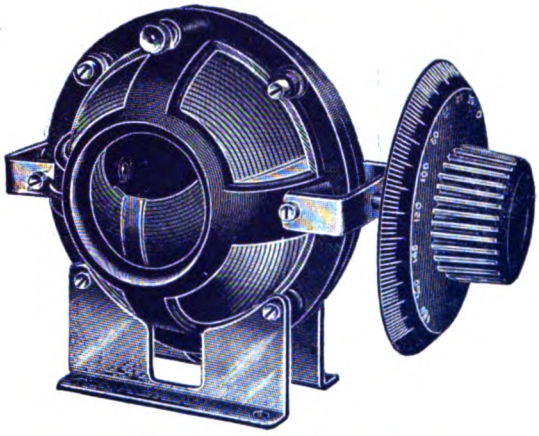

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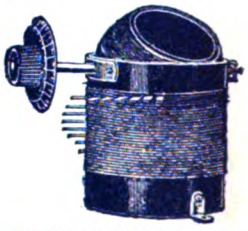

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This instrument covers the whole range of B.B.C. wavelengths. Stator and rotor are of hard moulded insulation and winding self-supporting. Tappings are so arranged that the first ten turns are tapped at every turn—the remainder at every tenth turn. Coupling continuously variable over wide range. Price, with knob, dial and fixing brackets, **19/-.**

IGRANIC Tri-plug Coil Holder.
For use with Plug Type Coils, it is arranged to take one fixed and two movable coils. Finest nickelled fittings, instrument finish. Price with stand and ebonite operating handles, **21-.** For panel mounting, **15/-.**

Independent Units.
Set of 3 with 2 ebonite operating handles and fixing brackets, **8/6.**

IGRANIC Bi-plug Coil Holder.
Similar in construction to the Tri-plug type but designed for use with two coils.
Prices with stand and ebonite operating handles, **16/6.**
For panel mounting, **10/6.**

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The WIRELESS WORLD AND RADIO REVIEW

ABOUT OURSELVES.

By The Editor.

NOT often does it occur that we consider it necessary to burden our readers with what may be termed "domestic" affairs affecting the organisation and policy of this Journal, but there are occasions when such matters may be of sufficient importance to provide the excuse for taking our readers into our confidence and sharing with them the satisfaction which we feel ourselves at any event constituting a milestone on the road of progress and prosperity of the Journal.

For the benefit of those of our readers who have not had a long association with us, it is not out of place to make reference to the fact that *The Wireless World* is now completing its fifteenth volume, having been in existence for well over ten years, or more than seven years before broadcasting was thought of in this country.

The first announcement which we wish to make to our readers is one concerning a change of proprietorship and control of the Journal. *The Wireless World* hitherto published by the Wireless Press, Ltd., has been taken over by Messrs. Iliffe & Sons, Ltd., the proprietors of a number of highly successful specialised publications, including *Experimental Wireless*, *The Autocar*, *The Motor Cycle* and *The Amateur Photographer*. This change carries with it the guarantee of an entirely independent policy unhampered by any association with commercial or other wireless interests. With the further object of ensuring that nothing shall interfere with this desirable freedom of action, the proprietors have obtained the consent of the Radio Society of Great Britain to transfer the obligations of Official Organ of the Society from *The Wireless World* to our sister journal, *Experimental Wireless*.

Our second announcement relates to the future style and character of *The Wireless World*. Commencing with the next issue, to be dated February 11th, the outward appearance will be entirely altered and modernised, the size of the page will be increased considerably, with a consequent addition to the space available for matter. This, together with additional pages, will enable us to introduce several new features and to extend the scope of the Journal to appeal to a wider circle of readers whilst sacrificing nothing of the character of the magazine in so far as it appeals to present readers.

In short, *The Wireless World* will in future be a bigger, a better, and we hope an indispensable journal to all wireless amateurs, with whom we trust we may include a very large number of professional wireless workers who are amateurs at heart.

Next week, therefore, you should look for *The Wireless World* in a new cover, but at the old price, and although there will be a minimum of 100,000 copies issued, make sure of your copy by placing an order with your newsagent at once. We mean to introduce *The Wireless World* to every wireless amateur, and we hope you, our present readers, will help us to do so.

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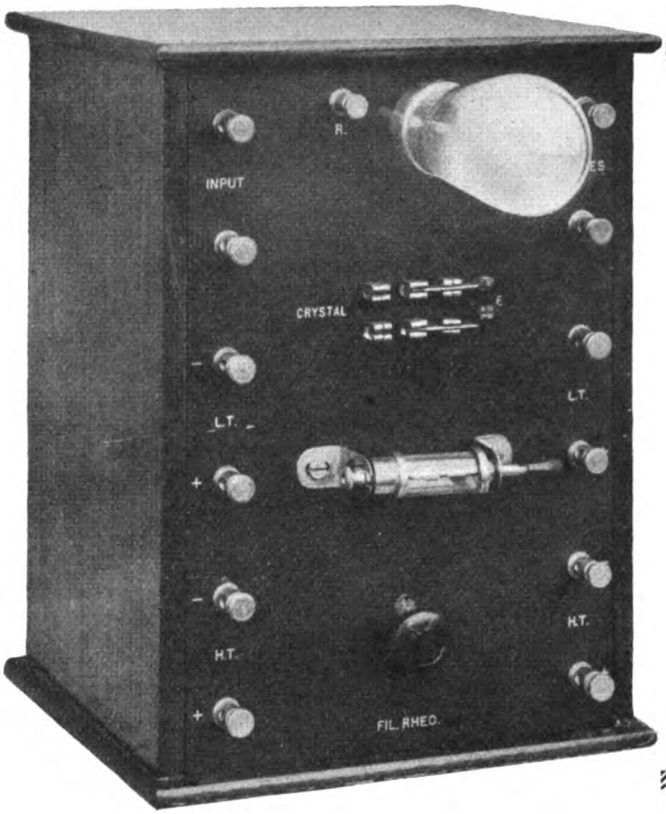

CRYSTAL —VALVE DETECTOR UNIT.

This unit may be attached to any low frequency amplifier and to a high frequency amplifier if desired. It is a particularly simple unit, being easily made and operated.

By R. H. Cook.

SEVERAL requests have been received from readers for an article giving details of a crystal or valve detector panel to match the instruments described by the author in *The Wireless World and Radio Review* of April 13th, May 28th and August 13th, 1924. The following description of a suitable unit has therefore been prepared.

A study of the two-circuit amplifier (April 30th, 1924) and the two-valve high-frequency amplifier (August 13th, 1924) will show the reader that they were not designed as instruments for a unit system, as the order in which the battery and telephone terminals are placed is not the same. But this slight drawback does not prevent one from making up an efficient and useful receiver with the addition of the panel to be described.

A scale drawing of the panel is given in Fig. 2. It will be seen that the height of this is 9 ins., to match the other panels, and the width is 6 ins. These dimensions make the panel of a size that will give a compact instrument without overcrowding the components.

On the left-hand side is a row of terminals to match those on the right of the H.F.

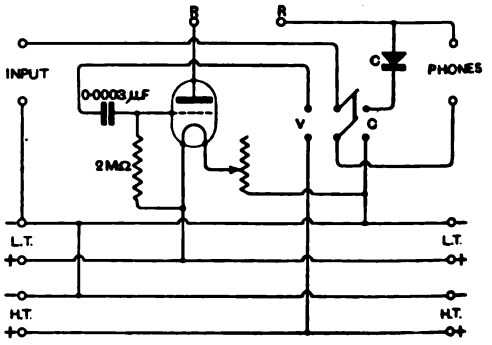

Fig. 1. The theoretical connections of the panel.

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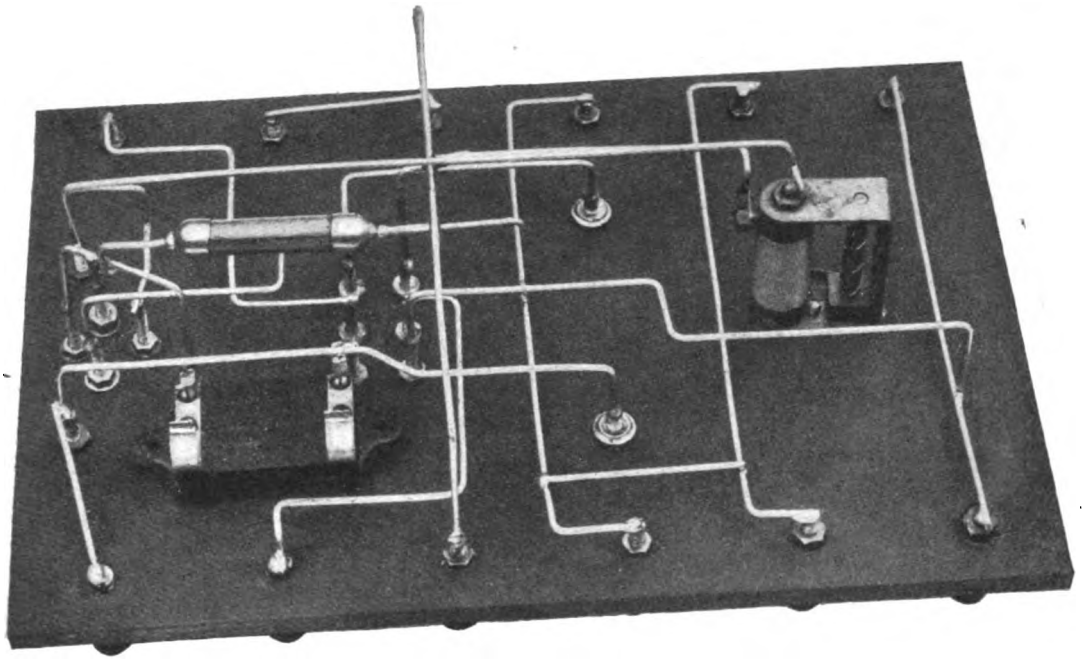

A view of the back of the panel.

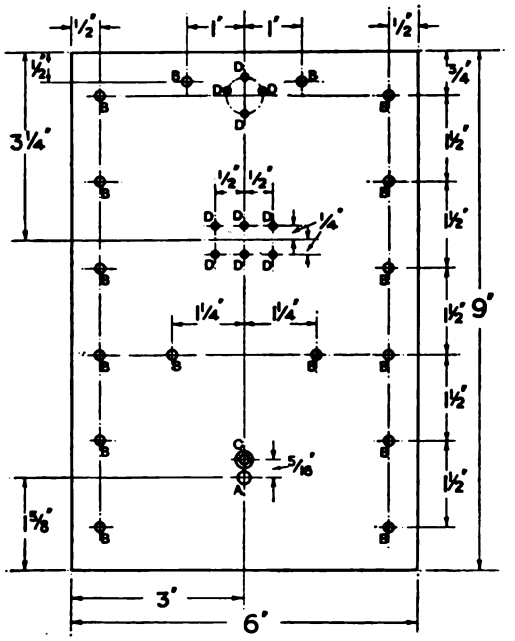

Fig. 2. Details of the panel. A, drill 3/16" dia.; B, drill 5/32" dia.; C, drill 5/32" and countersink for No. 4 B.A. screws; D, drill 1/8" dia.

panel; this allows short connecting wires to be used if desired. On the right of the instrument is another row of terminals to match those on the left, and one for the output (telephones) and battery terminals.

As may be seen from the photograph and figures, a valve holder, filament resistance, grid condenser and leak, a two pole change-over switch and a crystal detector are mounted on the panel. There are also two terminals for the wires to the reaction coil. When no reaction is required, these terminals must, of course, be short-circuited.

The theoretical diagram of Fig. 1 shows quite clearly the connections of the apparatus, and the circuit when a valve or crystal is employed as the detector.

The instrument is easily constructed. First true the panel to the dimensions given in the figure. This is a standard size, and so can be bought already trued. If the panel has not been rubbed down this should be done, using medium carborundum cloth.

Next mark out and drill the panel, using the drawing of Fig. 2. It is advisable to

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mark the position of holes with a scriber and not a lead pencil. When the lines and drilling centres are marked with a scriber very accurate work can be done.

Finally assemble and then wire the receiver. The layout is so simple that no clearance between them is clearly shown by the photograph of the back of the panel. When the wires are arranged in this manner there is very little possibility of them accidentally making contact with one another, and the ample spacing tends to

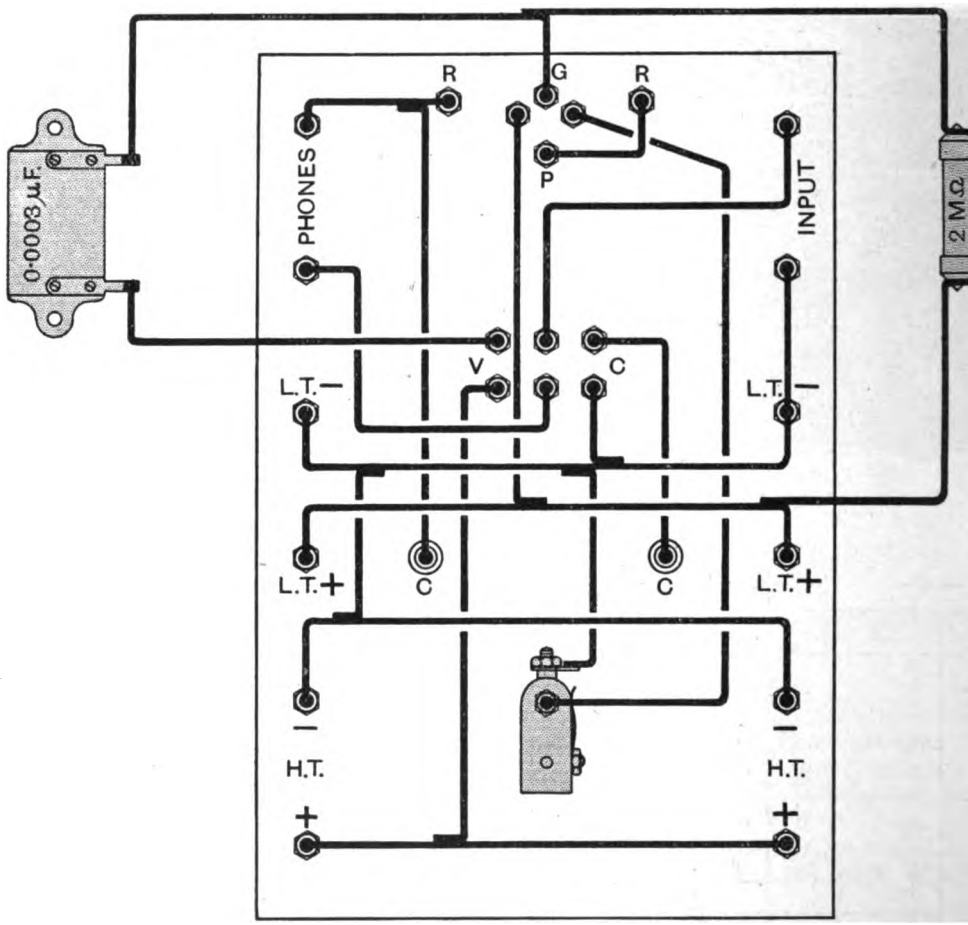

Fig. 3. The wiring diagram.

difficulty should be experienced in assembling or wiring. The wiring diagram of Fig. 3 shows the connections. All the wires are carefully soldered after having first been bent to the required shape. The neat arrangement of the wires and the ample high efficiency. When soldering wires to the grid leak be careful not to have the iron too hot, or the leak may be spoiled.

The method of connecting the unit to the components mentioned above will be quite clear from the marking of the terminals

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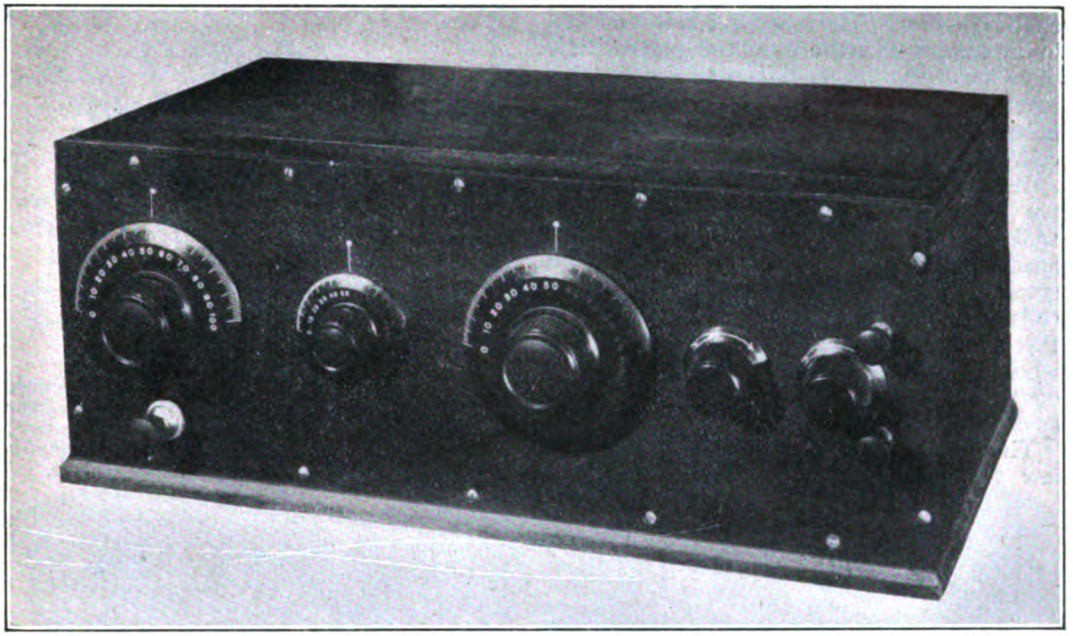

A view of the set. On the left is the variable condenser tuning the closed circuit coil. The next knob, which is smaller, controls the coupling of the aerial and secondary coils, while the third knob is for adjusting the reaction coupling. There are two filament resistances, and the telephones are connected to the terminals on the right of the set.

AN AMATEUR SHORT WAVE SET.

A description of the receiver employing a "Low-loss" Tuner used by Mr. Gerald Marcuse, G 2 NM, for the reception of American and Australian Amateurs.

ON the last day of my visit to the amateurs in Canada a short while ago, I happened to express a wish that I should like to take a set back on the boat and listen to the amateurs on my way home. That well-known amateur C 2 BN, Mr. Miller, of Montreal, said he would make me one. Someone produced the condensers, valve holders, a transformer, and the other accessories, and another found a cabinet, and very soon the set was completed and roughly calibrated on C 2 BN's aerial.

The set is shown in the accompanying photographs, and the connections are given in Fig. 1. From the diagram of connections it will be seen that the set has a valve detector and one stage of low frequency amplification. The aerial has a coil L_1 connected to it, consisting of a few turns of thick wire tied together, and to an ebonite spindle. A knob is attached to the spindle in order that the coupling with the closed circuit coil may be adjusted. The large coil, marked L_3, is wound basket-weave fashion with No. 16 D.C.C. wire, and has a tap which consists of a clip soldered to the wire. This coil is tuned with a variable condenser C_1, and is connected to the grid-filament of the detector through the usual grid con-

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denser and leak. A V.24 valve is employed as the detector. The reaction coil is mounted in the same way as the aerial coil, and consists of a few turns of medium gauge wire tied together. It may be seen in the photograph between the V.24 valve and the secondary coil.

It should be noticed that the components are well spaced. The tuning condenser is well away from the coils, and there is a space of two or three inches between the secondary coil and the reaction and aerial coils. A remarkable feature of the set is the ease with which it oscillates over the whole range—50 to 275 metres—with only one tapping, and with no dead spots such as one frequently meets with.

There is nothing remarkable in the low frequency amplifier, which has the

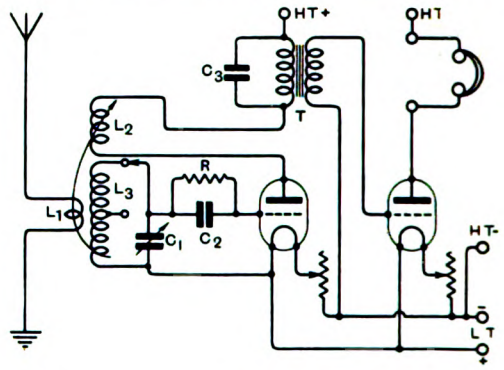
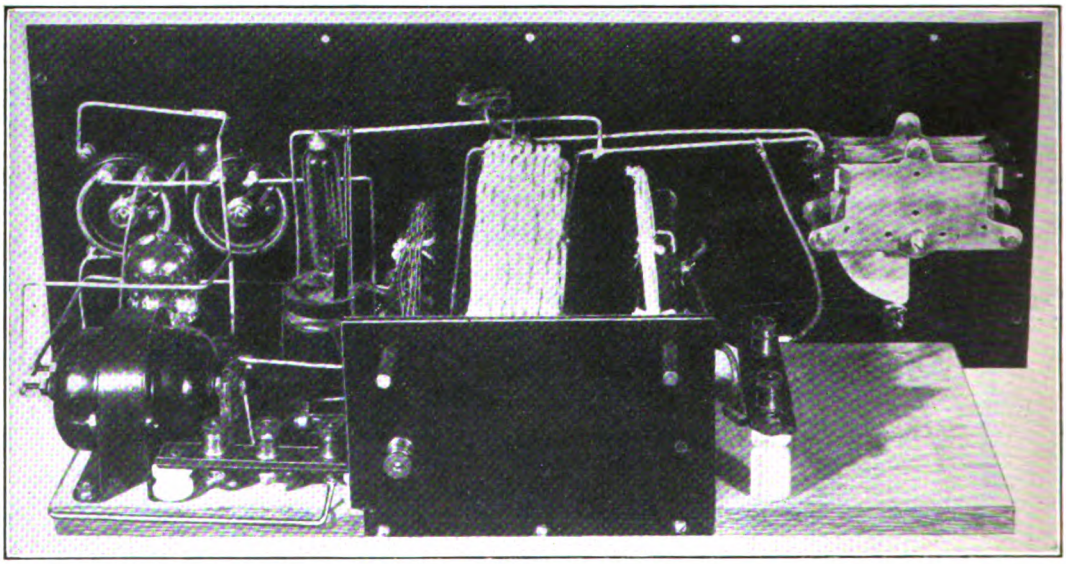


Fig. 1. Connections of the receiver. L_1 is the loosely coupled aerial coil; L_2, the reaction coil; L_3, the tapped secondary coil; C_1, the tuning condenser; RC_2 the grid leak and condenser; C_3, the by-pass condenser, and T the intervalve transformer.



A view showing the arrangement of the set. Looking from right to left we have the tuning condenser, aerial coil, closed circuit coil and reaction coil. Then the detector valve and the transformer and valve for the L.F. stage.

usual intervalve transformer, shunted by a small fixed condenser.

Unfortunately the ship coming home was very full, and I did not have an opportunity of using the set on the ship's aerial. A temporary aerial was rigged up, but I was very much bothered by interference from the ship's motors. The set has been in almost constant use since my return from Canada and receives signals from all countries.

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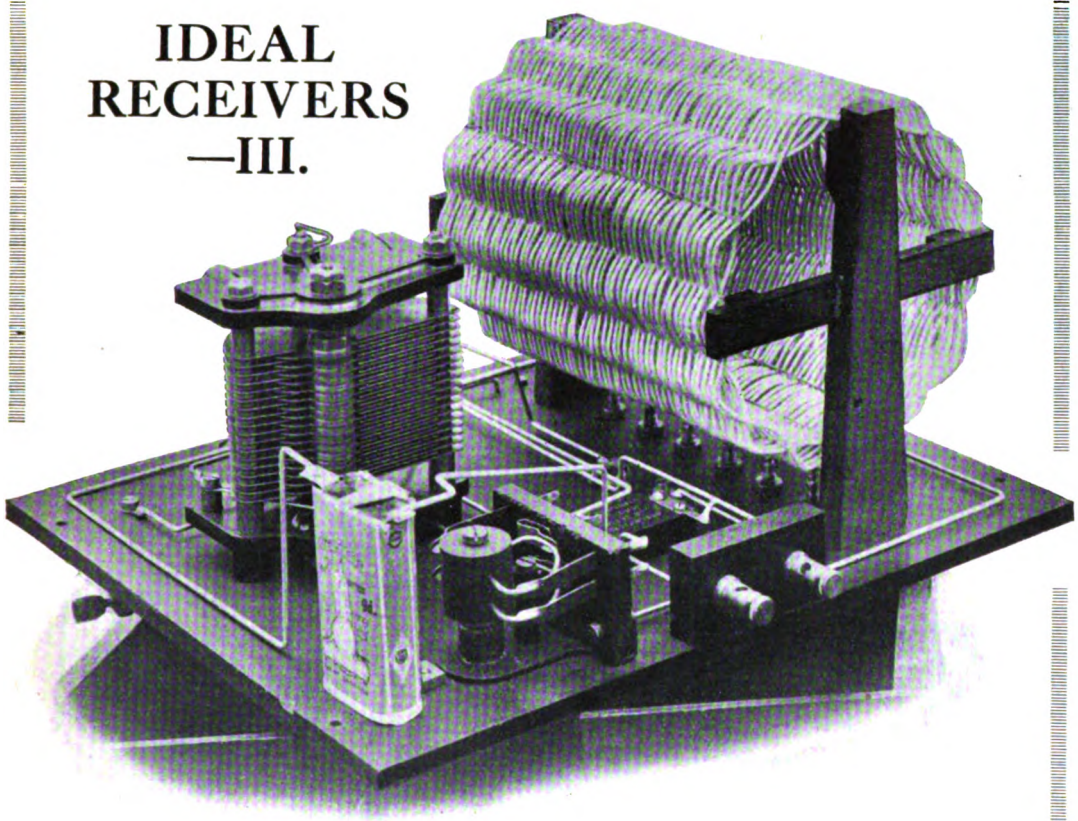
IDEAL RECEIVERS —III.



CONSTRUCTING THE COMBINED

CRYSTAL RECEIVER AND WAVEMETER

In the last number the author discussed the design of the instrument and described the construction of the coil. The remaining constructional details are given below, together with instructions for operating. The particularly neat arrangement of the instrument is shown by the photograph.

(*Continued from page* 568, *January* 28*th issue.*)

By W. JAMES

THE PANEL.

THE ebonite panel should be filed to 10 ins. by 8 ins. by $\frac{1}{4}$ in., and have the components mounted on it as indicated in Figs. 4 and 6. Mount the Clix sockets and plugs first, then the fixed condenser, and then the remainder of the components, putting the coil on last. Details of the connection strips are given in Fig. 5. The buzzer shunt consists of a number of turns of Eureka wire wound on a piece of ebonite rod about 1 in. long by $\frac{1}{2}$ in. diameter. The correct number of turns are found by experiment, as explained below.

CONSTRUCTION.

The components are mounted on a panel of ebonite measuring 10 ins. by 8 ins. by $\frac{1}{4}$ in.

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Good quality ebonite should be employed as leakage between the sockets connected to the coil may materially lower the efficiency. The arrangement of the parts may be seen from the photograph, the lay-out of the panel given in Fig. 4 and the wiring diagram of Fig. 6. It will be seen that on the left of capacity 0·002 microfarads and the shunt for the buzzer are also mounted on the under side of the panel. A connection strip with three terminals (A_1, A_2 and E) is secured to the back edge of the panel, and another strip with two terminals for the telephones is secured to the front edge of the panel.

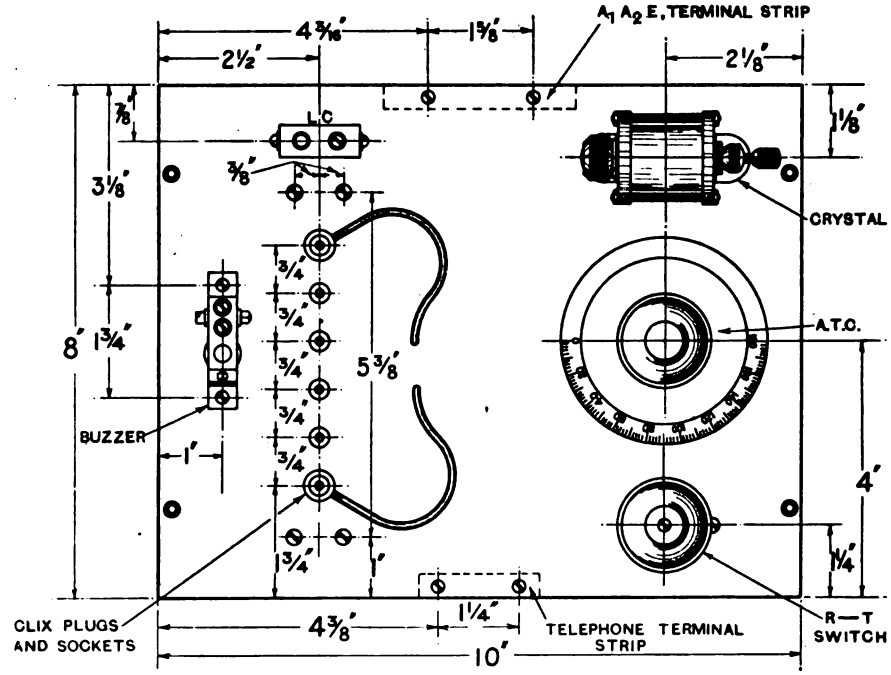

Fig. 4. Scale drawing of the top of the instrument showing the position of the parts. On the left we have the buzzer, the Clix sockets and plugs connected to the basket-weave coil, and the socket for a loading coil; on the right the crystal detector, the variable condenser, and the "receive-transmit" switch.

the panel is the tapped coil, the coil socket and the buzzer. On the right of the panel is the detector, tuning condenser, switch and buzzer battery. A telephone condenser of

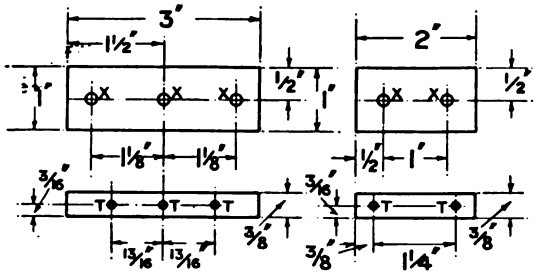

Fig. 5. Details of the pieces of ebonite which carry the terminals for the aerial and earth connections, and for the telephones. X = Drill 5 32-in. dia. T Tapped No. 6 B.A. × 5/16-in. and let into edge as shown.

The materials required are as follows:

1 Ebonite panel, 10 ins. by 8 ins. by $\frac{1}{4}$ in.
1 Ebonite strip, 3 ins. by 1 in. by $\frac{3}{8}$ in.
1 Ebonite strip, 2 ins. by 1 in. by $\frac{3}{8}$ in.
1 Variable condenser, capacity 0·0005 microfarad (Sterling square law type).
1 Fixed condenser, capacity 0·002 microfarad.
1 Coil socket.
1 High note buzzer (such as the Ericsson).
6 Clix sockets.
2 Clix plugs.
1 Crystal detector.
1 Switch, two-pole, two-position.
1 Battery (two dry cells).
5 Terminals.
1 Reel of No. 18 D.C.C. copper wire.
Small quantity of resistance wire (No. 26 or 28 Eureka wire).

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Connecting wire (bare tinned No. 18 copper).
1 Containing case to suit.

WIRING.

The wiring connections are given in Fig. 6, where the coil, connection strips, buzzer and switch, are shown to the side of the panel for clearness. The wiring is particularly easy and straightforward. Connecting tags are used when possible, and No. 18 tinned copper wire is employed. It will be found easier to solder the taps from the coil to the Clix sockets if the coil is unmounted and held a short distance from the panel. The tappings can be straightened when the coil is put back in position.

THE INSTRUMENT CASE.

A drawing of the box employed is given in Fig. 7. It is of simple construction, and in this particular case of three-ply wood and ordinary deal, finished off with a coat of stain.

USING THE INSTRUMENT.

To receive the short wavelength broadcast transmissions, connect the aerial to A_1 and the earth to E, and short circuit the contacts of the loading coil socket. With the switch in the "receive" position, put the wavelength plug in the socket connected to the end of the coil, and the detector plug in the socket connected, say, to turn 58. Roughly set the detector and tune in a signal. Then carefully set the detector, and find by experiment the best position for the detector plug. The coil and condenser will tune a normal aerial between 250 and 500 metres without setting the condenser in the series position below about 0·0002 microfarad. To tune in signals of longer wavelengths, such as 5 XX

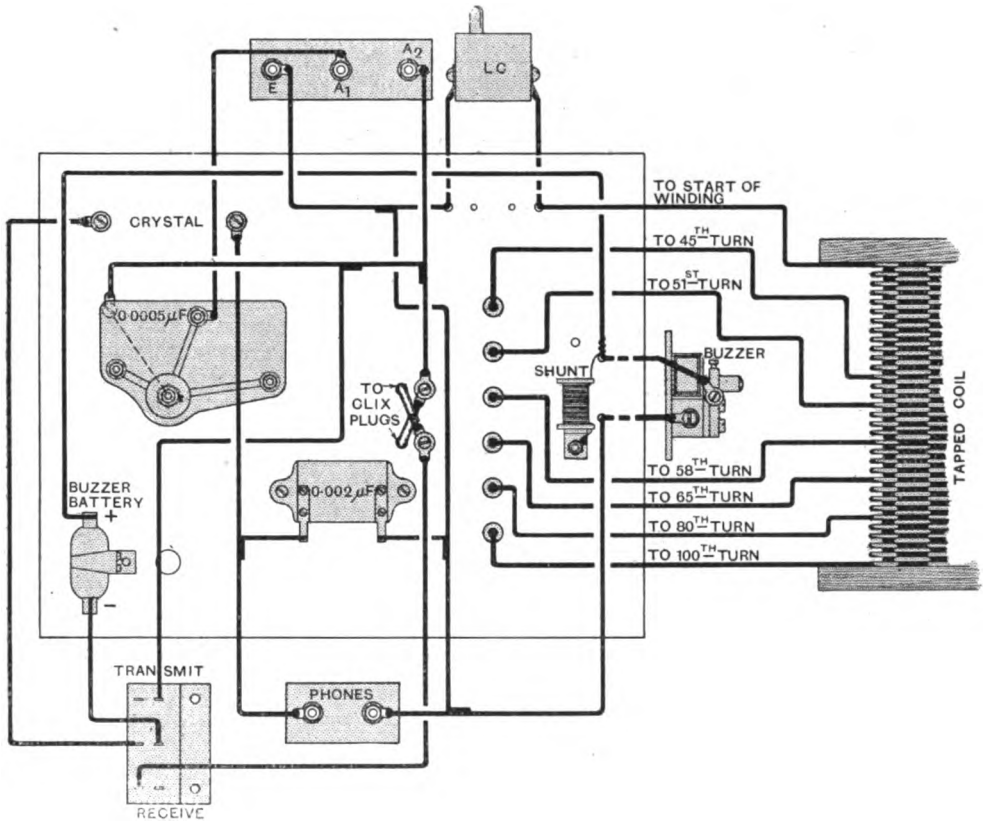

Fig. 6. The wiring diagram. The connection strips, loading coil socket, buzzer and tapped coil, are shown removed from the panel for clearness.

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remove the short-circuiting plug from the loading coil socket and insert a plug-in type coil. For 5 XX a No. 100 or 150 coil may be employed. Connect the condenser in parallel by joining A_1 and E with a wire, and connecting the aerial to A_2 and the earth to E.

High resistance telephones should, of course, be employed with a crystal receiver, and the best aerial and earth that can be made.

When the instrument is to be used as a wavemeter, short-circuit terminals A_1 and E, and put the switch in the "transmit" position. The telephones and detector are then disconnected from the coil, and the buzzer and battery are connected across the coil. Sparking at the contacts of the buzzer may be reduced by adjusting the resistance of the shunt. It is a good plan, therefore, to find by experiment the best value for the shunt. A usual shunt resistance is 20 ohms, corresponding with a length of 15 ft. of No. 28 Eureka wire.

Instead of exciting the circuit to be tested by holding the wavemeter near the circuit, it is easier and productive of better results if a small coil of about 5 turns of insulated wire is connected by flexible leads to the terminals A_1 E, and this coil held near the circuit to be excited. This inducing coil should be made quite rigid by binding with tape or string, and the connections wound quite tight into a flexible lead in order that its electrical constants shall not change with use.

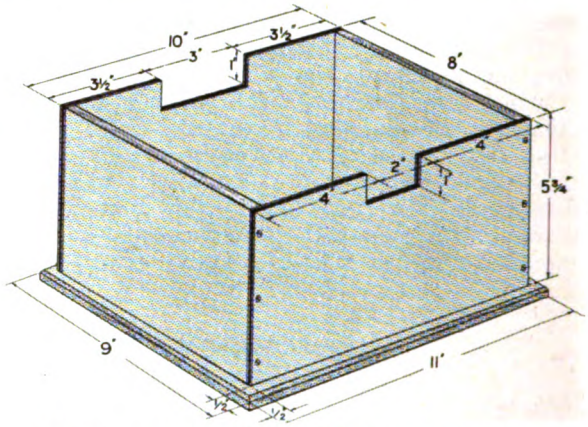

Fig. 7. A sketch of the box of the instrument, which is of simple construction.

THE GREENLAND RADIO STATIONS.

BEFORE very long it is expected that Greenland will have in operation an entirely new system of wireless stations. Plans for such a scheme had been made prior to the war, but during the world conflict these had to be laid aside. At the conclusion of hostilities, however, plans were revised and the preparatory work resumed, with the result that during the Danish royal visit to Greenland in 1921, wireless connection was first established between the King's ship on the West Coast of Greenland and the International Telegraph Service.

The stations now nearing completion are situated at Julianchaab, Godthaab, and Godhavn, on the West Coast, and at Angmagssalik on the East Coast of Greenland. The contract has been in the hands of the Danish Radio Company.

The Julianchaab station, constructed on the Poulsen-Arc system and employing a power of 5 kilowatts, has an aerial of the umbrella frame type suspended from a mast some 250 feet high, surrounded by six smaller masts. This station has been designed specially to communicate with the Faroe Islands, a distance of more than 1,300 miles. Of a smaller type are the stations at Godthaab and Godhavn, which will cater only for local traffic and will use a power of ½ kilowatt. The East Coast station at Angmagssalik, erected at the special request of the Danish-Icelandic Committee, is primarily intended to transmit meteorological reports for the benefit of fishermen and should prove of great value in providing warnings of approaching storms.

The greatest obstacles in the construction of the stations have been their isolated situation and the difficulties of transport over the vast distances involved, in addition to the fact that work of this kind is impossible during the winter. O. L. V.

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BRITISH AND AMERICAN RECEIVERS.

The author of this article is in a position to discuss the relative merits of British and American components in an authoritative manner, as he has spent a good deal of time in the States. It would appear that while British sets are superior in many respects, the British manufacturer does not produce so many useful devices for the amateur and home constructor.

By N. P. VINCER-MINTER.

IN view of the fact that the regulations restricting the holder of a broadcast licence to the use of British-made sets and components came to an end with the new year, it is not out of place to consider briefly what effect this is likely to have on British sets and components.

It will undoubtedly lead to a large influx of foreign manufactured goods, and as by far the largest amount is likely to come from America, it would be well for us to consider in what respect, if at all, American sets and components are superior to those manufactured in the United Kingdom.

It may be said definitely, in the first place, that taken as a whole, British sets and components are superior to those manufactured in the U.S.A., both in quality of workmanship and in quality of reproduction. Nobody who has listened to the reproduction of music and speech on both a high-class American and a high-class British set would be the least doubtful which to purchase; in fact, it may be said that even a moderately good quality British set is to be preferred, from the musician's point of view, to the very best that America produces.

This is not so much due to the fact that American manufacturers are lacking in skill in the design of good transformers, etc., as to the mentality of the American people. Anybody who is intimately acquainted with modern American music, or has had the opportunity of comparing the performances of average quality orchestras to be met with in theatres and restaurants in the two countries will readily understand the true reason why the quality of reproduction in British sets is so greatly superior to that in

The Bestone 5-valve receiver with built-in loud speaker and battery compartment.

those which emanate from the U.S.A. Indeed, the performance of an orchestra which would be considered but mediocre in England is usually termed "highbrow" on the other side of the water. The same may be said of wireless sets and loud speakers, particularly the latter. Turning to the other side of the question, however, it must be admitted that from the point of view of selectivity, sensitivity, ease of control and variety—not to mention artistic appearance—the palm must be awarded to the Americans. This is also explicable by means of the mentality and environment of the American people. The average American possesses a strong trait in his character for going one better than his neighbour, and in the matter of wireless, this exhibits itself in the form of logging the largest possible number of stations. It must be remembered that even here in England, the first question that the prospective buyer of a valve set usually asks is whether the set is capable of receiving all the B.B.C. stations and some continental, thus indicating a desire not only to be able to receive *all* the transmissions from his own country but some from foreign countries also. Owing to geographical size, this desire

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is fairly easily met in the case of the Englishman; but the American who also exhibits the same desire, only in a more pronounced form, must possess a far more sensitive and selective set to fulfil this purpose. When one considers the vast size of the United States, where often a man may be living surrounded on every side for a thousand miles by his own country, the very bad atmospheric conditions, especially in the southern states, and the large number of stations operating on a comparatively narrow band of wavelengths, it is not to be wondered at that the Americans are far ahead of this country in producing sets in great variety of really selective and sensitive "DX" capabilities.

From the point of view of artistic appearance also, American-made sets show a marked superiority over those made in this country. In this respect we are not referring to the hundred guinea type of cabinet set, whose artistry cannot, of course, be denied, but to the ordinary type of good quality set which sells at prices ranging from £20 to £40 or thereabouts.

The typical American type of set, where the valves are mounted behind the panel in a rather elongated form of cabinet, presents a far more pleasing appearance than do the sloping panel type or even the upright type where valves are behind the panel. The American set, with its false bottom enabling the whole of the "works" to be withdrawn and stood independently on the table, is also far better from the point of view of ease and efficiency in wiring. It is gratifying to note that some British manufacturers have already realised this point. One has only to glance through the advertisement pages of any of the American radio journals to note the large number of really efficient and attractive-looking sets at not unreasonable prices, to be acutely aware of how much greater is the range of choice accorded to American purchasers. Although, of course, some of the claims made in these advertisements are typically American, it must be admitted that on the whole the sets are highly efficient.

The cabinet work of the average American set, particularly the low priced ones, is usually much better than that which is to be found in English sets. The cabinets are usually robust, and the general finish superior.

SHORT WAVE SETS.

There is undoubtedly a very great need on the British market for efficient sets for low wavelengths from fifty up to about two hundred metres. The Americans are very much to the fore in this respect, and there are a great number of really efficient low loss sets to be had for this very interesting band of wavelengths. British manufacturers, on the other hand, are very much behind the times in this respect; the general idea which appears to exist among them is that the use of the ordinary standard design of set employing plug-in coils is all that is necessary.

It would be all to the good, therefore, if some of the more progressive manufacturers in this country broke away from conventional design and evolved something that was not merely somebody else's set "dished up" in another form.

COMPONENTS.

Turning to the question of components, the general quality, with one or two glaring exceptions, is, as we have mentioned previously, superior to American made components, but the same cannot be said from the point of view of variety and ingenuity.

With regard to valves, we have nothing to fear from the Americans. British-made valves are on the whole far better than any foreign manufactured valves, more especially those valves designed specially for low frequency amplification. British valves are more efficient technically, are longer lived, and are, comparatively speaking, to be had in a far greater range of characteristics than those in America. Another important factor is that they are infinitely cheaper, which fact, of course, must not be taken to indicate that they should not be cheaper than they are. There is, however, a great opportunity for an enterprising British manufacturer to produce a good "soft" valve for rectification purposes, for there is undoubtedly a big demand for them, especially among single valve users who have to rely upon Dutch manufacturers for this product. In America some quite remarkable results have been achieved on single valve sets with soft valves requiring an anode voltage of about 20 volts.

Turning to low frequency transformers, the British-made article again exhibits a very marked superiority. Indeed, the performances of some of the cheaper variety

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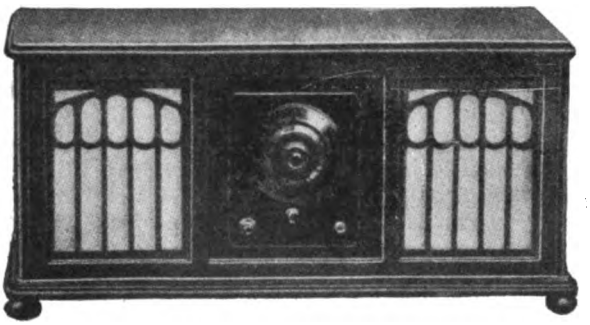
of American transformers would bring a blush to the cheeks of even the most hardened junk manufacturer in this country.

Loud speakers are another instance in which we lead and others follow, or at least attempt to do so. There are, of course, one or two makes of high-class British loud speakers to be obtained in America, but these cannot be classed as of American design. The quality of reproduction in the average American loud speaker is very raucous. Any foreign visitor walking through a high-class radio store in New York during broadcasting hours has no need to be informed of this fact; in fact, the particular make of loud speaker, which is usually designated as the last word in tonal purity in America, would scarcely find a place in the average "middlebrow" household in England. The inferiority of the American loud speaker is especially marked in the cheaper brands, and for five dollars it is possible to purchase an instrument whose performances are, as its makers truthfully assert, unparalleled.

GADGETS.

Having said this, however, it must be admitted that the American "radio-fan" has a far larger range of components and useful "gadgets" at his service than is the case with the English amateur, apart from the fact that there are many indispensable components in which America holds first



This receiver has four valves, including one stage of high-frequency amplification. The loud speaker is built in, and there is room for the batteries. One knob tuning is employed to tune the aerial and H.F. circuits.

place from the point of view of quality. By far the most important of these is variable condensers. So far as we are aware, there is not a single variable condenser on the home market at the present time which can truthfully be said to compare favourably with a high-class American article. The first point which strikes one on examination of an American condenser of first class quality is its extremely robust construction. It is un-

The Radiola Super-Heterodyne Receiver.

doubtedly a real "engineer's job," and is not reminiscent of a "made-in-Germany" toy, an aspersion which cannot altogether be withheld from a great many high-class English condensers. One can insert one of these condensers into a set with a definite feeling of assurance that after many months' or even years' usage the plates will not touch nor in any way get out of alignment. The Americans also produce some most excellent variable condensers having a geared movement enabling very fine tuning to be obtained. These gears are not merely stamped out and roughly assembled but are very precisely machined. From actual experience it can be said that the presence of this gearing does not in any way reduce the electrical efficiency of the condenser; in fact these condensers are electrically as well as mechanically sound. The variable grid leak, another small but important component, is another item which has been brought to a great pitch of efficiency and reliability in America, the usual design being of the "fixed-variable" type, in which a number of fixed grid leaks of definite value are placed in series with each other by means of a rotary switch. The variable portion of

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the leak is, of course, in series with this, and as it has only a range of ½ megohm, very fine adjustment of grid potential can be obtained, as it requires very many turns of the " knob " to cover the ½ megohm range.

Another component which has been greatly neglected in this country is the variocoupler. This extremely useful and neat component is in almost universal use on the other side of the water, and it would be an excellent thing if it were possible for the British public to obtain these in greater variety. We are fairly well supplied with variometers, but even here there is much room for improvement in the design of low loss formers.

One particular component for which there is a very great need in this country is a low loss tuner unit for short waves of from 50 metres upwards. In America it is possible to obtain these units in great variety of design, the usual design consisting of a skeleton-wound aerial, secondary and reaction coil, mounted very efficiently, with a marked absence of metal spindles and such like absorbers of energy on these very high frequencies. It is greatly to be regretted that these cannot be obtained in this country. Complete Reinartz tuning units for incorporating into sets are also greatly the vogue among American manufacturers. Complete L.F. amplifying units mounted on a rigid framework for incorporating into multivalve cabinet sets are also to be had. With the exception of the transformer, it may be said that the design of them is excellent.

The variety of reasonably priced lead-in tubes and earthing switches to be obtained on the other side is greatly in excess of those obtainable in this country. With the exception of a few highly priced ones, these components seem quite unheard of in this country, the usual article supplied by the local dealer being a flimsy article with nuts of quite inadequate size and ebonite tubing of doubtful quality.

Aerial masts are a further instance in which we are sadly deficient. It should be possible to obtain jointed masts for aerial erection at reasonable prices, but this is certainly not the case at present.

A very important point, to which it is gratifying to note that British manufacturers are at last paying some attention, is that of ebonite, it now being possible to obtain good quality ebonite in standard sizes. In America, however, it has been possible for the past three years to obtain good quality ebonite or bakelite, either matt or polished, each piece of ebonite being enclosed in a sealed envelope, thus obviating any possibility of the panel being scratched whilst in the possession of the dealer.

The question of cabinets also might receive attention, the average cabinet sold to amateurs usually being constructed very flimsily of three-ply wood and French nails, and polished either in a very inferior manner or merely stained.

It is possible in New York and other American cities to go into any reputable radio store and ask for a complete set of parts to construct the set described in such and such a radio journal, and in return one will be handed an attractive cardboard box containing the complete set of parts according to the author's specifications, the parts being arranged in boxes in a similar manner to sets of Meccano parts. Many manufacturers also make up boxes of parts to construct sets according to their own design, the box containing blueprints and full instructions, in addition to the complete set of parts.

A four-valve receiver by the Michigan Radio Corporation. This set has one stage of high frequency, detector, and two stages of low frequency amplification. The set is equipped with a self-contained loud speaker, and there is ample room for the batteries.

Attractive accumulator cases are further items which might well be introduced into this country, the usual practice over here being either to hide this article under the table out of sight or to place a rather dirty and unsightly-looking crate next to an otherwise neat outfit. American accumula-

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tor manufacturers usually supply attractive mahogany boxes for their accumulators, these boxes being fitted with terminals, of course. When it is desired to remove the accumulator for charging, the box is opened and the accumulator is removed in an inner crate complete with carrying handle. High tension batteries are similarly housed.

Many components obtainable at almost every radio store in America are quite unknown here. Among these are "variotransformers," which are complete units consisting of an efficient H.F. transformer with variable coupling between primary and secondary, and with a variable condenser incorporated into the unit. Complete neutrodyne transformers to cover a specific band of wavelengths and oscillator coupling units and intermediate frequency amplifiers for incorporating in "super-hets" are further instances of this nature.

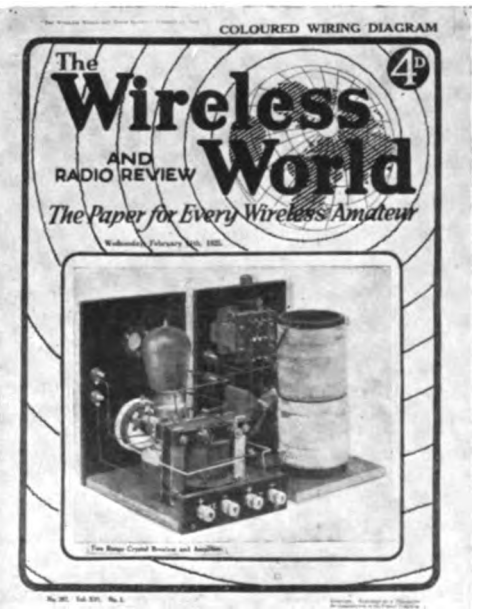
Another small but ingenious component to be obtained over there is what is known as the "plug-adaptor." When one possesses a set using plugs and jacks for 'phone connections, it often happens that one desires to try another pair of telephones or loud speaker, and a difficulty arises owing to the fact that the extra pair of telephones are not fitted with a plug. In America it is possible to purchase plugs whose "handle" consists of a small flat platform on which are mounted two or more pairs of terminals, thus allowing telephones not provided with jacks to be connected. Other plugs may be obtained containing spring clips into which the tags of the telephone may be quickly inserted.

There are a large number of very ingenious and necessary little components such as the foregoing which may be obtained at almost any radio dealers in America, but which are quite unobtainable over here. Taken on the whole, it is mostly in the matter of these small but extremely ingenious and well made "gadgets" in which the American manufacturer excels. Of course it may be argued that the British amateur is capable of constructing most of these "gadgets" himself, many of them being far more ingenious than the American-manufactured article, but that is not the point; the British amateur is also quite capable of constructing a set equal in efficiency to the best manufactured set on the market, but this cannot be taken as an argument for offering no complete sets for sale in this country.

It therefore behoves our home manufacturers, if they do not desire to unduly "feel the draught" caused by the possible advent of an avalanche of American components, to set their house in order in this respect. That they are capable of producing as good and even better sets and components than the American is undoubted, but it possibly needs an impetus such as the opening of the British market to American goods, in order to rouse them from their lethargy.

It is earnestly to be hoped that we shall not have a flood of foreign junk components dumped on the home market, as American and Continental junk is on the whole far more "trashy" in design and manufacture than anything the British junk manufacturer has evolved, even in his most inspired moments.

LOOK FOR THE NEW COVER NEXT WEEK



This is an illustration of the new cover design for the next issue of the *Wireless World*. In our Editorial of this week we refer to the changes which are to be incorporated in this new series of the Journal.

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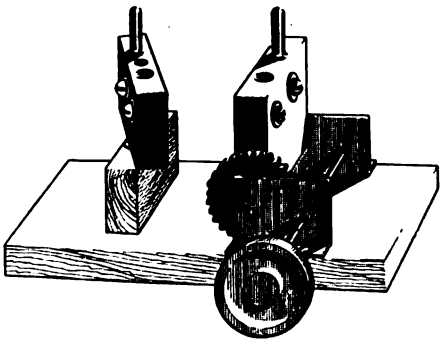
READERS' PRACTICAL IDEAS.

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

Coil Holder with Slow Motion Adjustment.

IN the accompanying diagram a method is given for constructing a two-coil holder. Coil holders are somewhat expensive and by following the design given a considerable saving in cost may be effected. For critical adjustment a double movement is provided, and it will be seen that one holder can be rotated whilst the other is operated through Meccano gearing.



A home-constructed two-coil holder.

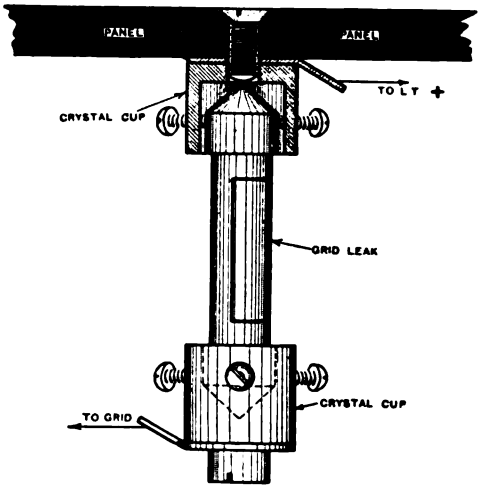
The angle pieces are made up from No. 16 gauge brass, while the rods are Meccano spindles. The base is a piece of ½ in. or ¾ in. hard wood, as is also the block which carries the pivotted holder. The pivot is a length of 4 B.A. studding screwed tightly into the wood block, and allowing the ebonite holder to rotate fairly stiffly. If desired, a handle can be attached to the rotating holder to eliminate hand capacity. Flexible leads are taken to four terminals to pick up connection with the remainder of the receiving circuit.

The reader will find that this coil holder is both simple and inexpensive to make up and with it most critical adjustment can be obtained. T. C.

Mounting Grid Leaks.

IT is not always realised that crystal cups are suitable in size for clamping on to the ends of grid leak resistances. Crystal cups are obtainable with a centre hole in the base which provides for mounting on the underside of the panel, and with screws which normally clamp the crystal in position.

The method of using a pair of crystal cups is shown below, and it will be seen that a



Using crystal cups for making contact with a grid leak.

screw has been inserted into the end of the lower one to carry a tag to which a soldered connection can be made. G. N.

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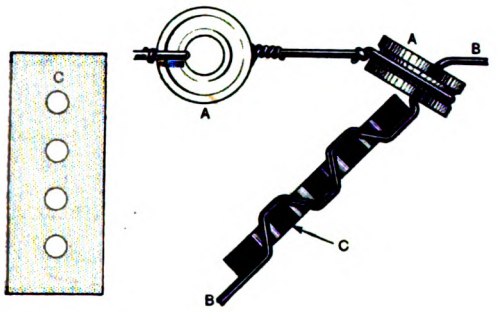
Terminating the Aerial.

AN adjustable method of aerial termination is much to be preferred to the usual arrangement in which a portion of the wire is bent back and twisted either round the down lead or the aerial itself. With the end of the aerial made off by twisting it is not an easy matter to regulate the tension so that the aerial hangs reasonably taut.



Adjustable aerial termination.

The diagram shows an easily constructed aerial adjustor. It is made up from a piece of ebonite (C) drilled with four holes through which the aerial wire (B) passes.

H. A. T.

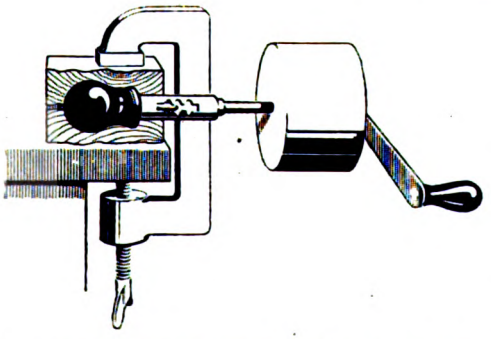
Winding Single Layer Coils.

BELOW is shown a simple device for constructing single layer tuning coils. The arrangement will be seen to consist of a ratchet screwdriver clamped to the bench by means of two blocks of wood and carrying a wooden cylinder on its stem. A suitable handle may be secured on to the end face of the wooden cylinder.

The ratchet adjustment is set so that the handle can only be rotated in one direction and as a result the wire passing from the reel on to the former cannot run slack.

The wooden cylinder should be made to a suitable size to meet general requirements, and the formers may consist of cardboard or ebonite tube. A set of cylinders of various sizes should be constructed, and if sketched out the job can be passed to a wood turner who will make them up quite cheaply.

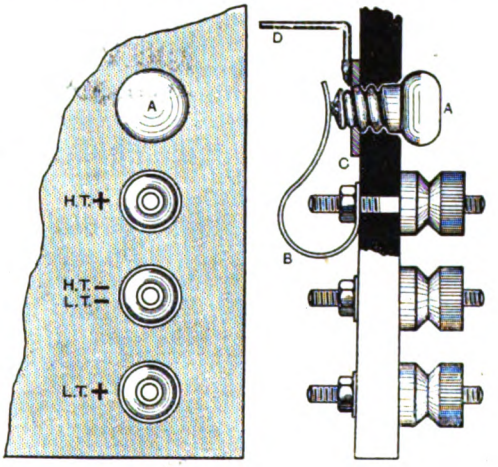
O. I.



A coil winder making use of a ratchet action screwdriver.

To Save Your Valves.

A FLASH lamp bulb let into the instrument panel in no way detracts from the appearance of the set, and may save pounds by preventing filament burnouts.



A flash lamp connected in the high tension battery lead will prevent the valve filaments from being destroyed by accidental contact with the plate socket.

The bulb is mounted on the panel and is connected in the positive lead from the H.T. battery. Accidental misconnection will only result in the destruction of the bulb, which can be replaced for a few pence.

A section of the instrument panel is shown, and the bulb A may be either screwed into the ebonite or a suitable holder C fitted. B is a piece of brass spring which makes reliable connection with the centre lamp contact, whilst D is the H.T. lead to the receiving apparatus.

L. W. A.

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STABLE H.F. AMPLIFICATION WITH SELECTIVITY.

The author describes a circuit for high-frequency amplification which is easily handled and remarkably effective. As will be seen, an uncommon circuit is employed.

By J. SOMERSET MURRAY.

THE following notes were suggested by an article in *The Wireless World and Radio Review* for September 19th, 1923, by W. James, on "Short Wave H.F. Amplification." Though no claim is made for novelty or originality, it is hoped they may interest experimenters. They are an attempt to apply the electrostatic method of coupling, without the attendant disadvantages introduced by self-oscillation and instability where tuned circuits are used. No real advantage other than selectivity is gained when employed only as a one-stage high frequency amplifier.

THE PRINCIPLE OF THE CIRCUIT.

The series circuit suggested in Fig. 5 of the before-mentioned article is repeated as Fig. 1.

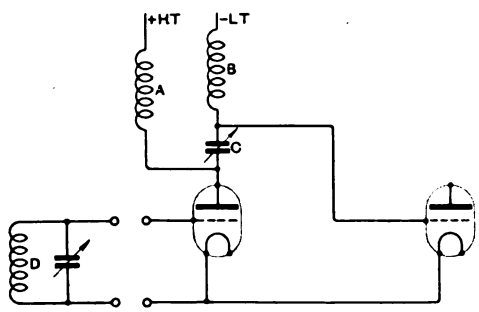

Fig. 1. *The principle of the circuit.*

In this, BC is the series resonant circuit. It is suggested that the condenser C should be of small capacity, *i.e.*, below 0·0001 μF. In practice it was found that the amplification obtained varied considerably with the value of the condenser C, even over quite a small range of wavelengths. Furthermore, the choke A through which the H.T. was fed to the anode, more or less took control of the tuning. By that I mean that when reaction was applied to the tuned circuit D and the set tuned to a strong carrier wave, it would oscillate when detuned in the direction of the optimum λ of A. It would perhaps have been more stable if the choke

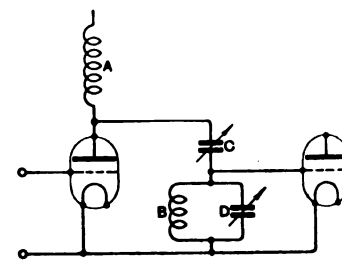

Fig. 2. *A modification of Fig.* 1.

used had been of resistance wire, but this was not tried. The actual choke used was 180 turns of 30 D.S.C. wound on a 3 in. ebonite former. However, it showed that the choke played too important a part in the tuning for results to be really satisfactory.

The next step was to tune the circuit BC by a parallel condenser across B; and the circuit when redrawn is shown in Fig. 2.

In the actual test circuit, C was 0·00005 μF maximum and D 0·0005 μF maximum. The same choke was used. When C was very small, *i.e.*, 0·000015 or so, a tendency to self-oscillate was noticed, and at the same time variations in C called for variations in D, if the wavelength was to be kept constant; but above a certain value, signal strength and tuning remained constant over a considerable range of variation in C.

A receiver was constructed embodying this principle for two stages of H.F. amplification. While instability was noticed if

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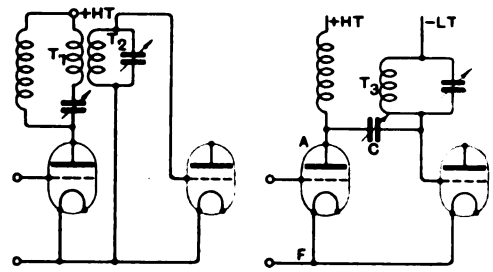
C was again made very small, for values above 0·00004 μF the set could be made perfectly stable.

ANALYSIS OF THE CIRCUIT.

When examined closely the circuit is seen to be very similar to Fig. 6 in Mr. James' article, shown here as Fig. 3.

Actually the only difference is the employment of an auto-coupled transformer T_3 in place of T_1T_2, as shown in Fig. 4. Incidentally this accounts for the variations in tuning when C is small.

However, C may also be considered as an electrostatic coupling condenser between the H.F. potentials across AF and the tuned grid circuit. In fact before the value of C is decreased so much that it seriously affects tuning conditions a loose-coupling effect is noticed; selectivity is increased to such an extent that, quite apart from any distortion which may or may not be introduced by reaction, the set acquires a very low pitch; this disappears when C is made larger, and the increased purity is accompanied by atmospherics. To obtain selectivity with more amplification, reaction may be employed on the tuned grid circuit and a larger value of C inserted. This set works quite satisfactorily both as regards selectivity and stability. The great advantage is that it enables the valves to be used with a considerable normal negative grid voltage without introducing external damping to counteract self-oscillation. The circuit employed by the writer is shown in Fig. 5.



Figs. 3 and 4. In Fig. 3 a tuned transformer is employed, and in Fig. 4 a tuned auto-transformer.

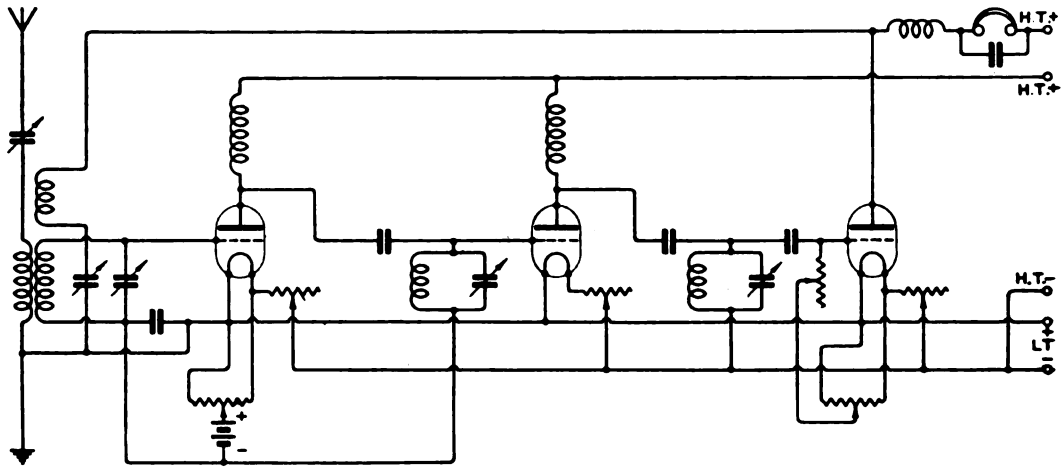


Fig. 5. The final circuit used by the author.

RUSSIAN AMATEUR HEARD.

Sooner or later the amateurs of Russia were bound to make themselves heard in Western Europe and this has apparently been accomplished for the first time by a transmitter in Novgorod. His call sign, R-1FL, was picked up at 9.20 p.m. (G.M.T.) on January 19th by Mr. Marcus F. J. Samuel, of St. John's Wood, London.

R-1 FL was calling CQ on about 110 metres with an A.C. note and was heard at R 5 on a two-valve receiver

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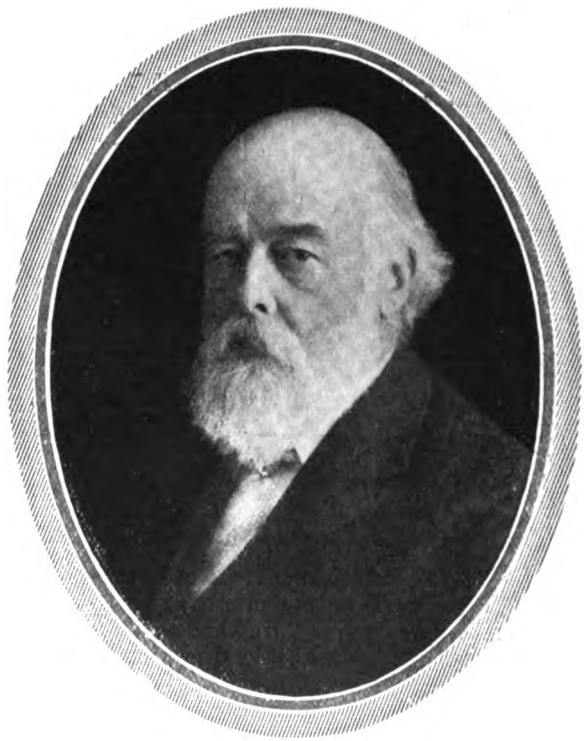
MATTER AND RADIATION.

The Presidential Address delivered before the Radio Society of Great Britain on January 21st, 1925.

By SIR OLIVER LODGE, F.R.S.

THERE are three societies in London which specially deal with radiation: the Radio Society is one, the Röntgen Society is another, and the Optical Society is a third. They deal with radiation from different points of view, but they are all primarily concerned with waves in the ether. Optics is an ancient seience which speaks for itself; it treats of the special kind of radiation which affects the eye and photographic plates. In a sense the whole gigantic subject of spectrum analysis belongs to it; but probably that has a society of its own: it certainly has disciples and eminent workers of its own who employ marvellously perfect instruments and attain results of surpassing accuracy. The obtaining of extremely well defined and complicated line spectra, and the deciphering of their message, strike me as among the most remarkable and beautiful of the activities of man in the physical realm. To the uninitiated eye a spectrum looks like nothing but confusion—as the stars do on a clear wintry night—innumerable and hopelessly unintelligible and confusing. But in both regions law and order reign and have been apprehended by the human mind. Depend upon it that the Universe is intelligible—ultimately intelligible—however complicated and hopeless it sometimes appears.



Sir Oliver Lodge, F.R.S., the President of the Radio Society of Great Britain.

The subject of spectrum analysis has a past of considerable magnitude, going back to no less a person than Sir Isaac Newton. The Röntgen Society, and the Radio Society, are new comers, and take up their subject as developed chiefly through the years which have elapsed of the present century. They have taken hold of facts discovered at the end of the Nineteenth Century, and have applied them to human life in a rapid and astonishing way. They both deal with ether pulses, but of how different size! One deals with the biggest waves which humanity has generated and used, waves exceeding but comparable in size to the

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aerials which have excited and emitted them. The other deals with ether pulses of excessive minuteness, smaller even than the atoms of matter, the smallest waves which have ever been detected and employed.

Everyone knows, however, that the properties of ether are so simple and fundamental that all waves, of whatever size—whether radio waves, or luminous waves, or X-rays—all travel at exactly the same pace; and their laws of transmission are fairly well known. To detect the smallest waves, phosphorescent material or photographic plates must be used: to detect the intermediate waves, the physiological instrument called an "eye" suffices; to detect the largest waves, a rectifier has to be used, either a crystal or a vacuum valve, and then, by aid of that remarkable invention the telephone, they make appeal to the human ear.

It may be said (with some appearance of paradox) that we know less about how the luminous waves are detected than about either of the others. That which goes on in the retina of the eye we are very much accustomed to, but no complete or satisfactory theory has yet been evolved; and the subject of colour vision is still a theme of controversy. Moreover, though we know how to generate radio waves and X-rays, we do not yet know how to produce light; nor, save for the eye, have we any satisfactory measuring instrument for it. We produce X-rays by suddenly stopping electrons, flinging them at high speed against a target. We produce radio waves by setting up electromagnetic oscillations, using the two fundamental properties of the ether, elasticity and momentum—which Clerk Maxwell proved to us were electric and magnetic respectively. The electric properties of the ether give us the necessary recoil, or elastic recovery from the strained condition that we call electric charge; and the magnetic properties of the ether give us the necessary momentum or impetus which enables the discharged current to rush past the position of equilibrium and pile a charge up in the opposite direction—just like the momentum of a pendulum bob or the wire of a musical instrument.

But if we seek to generate light waves, neither of these methods suffices; the waves are too small for the one operation, and too big for the other. All we can do, at present, is to throw the atoms of matter into the confused and irregular agitation that we call heat; or in some other way get them to clash together (as they do in chemical combination), and trust to the properties of the atoms themselves to emit waves of suitable size—as a bell does when it is struck by a hammer. The generation of light is still a sort of blindfold method; you make a body hot and await the result.

Atomic Construction.

All this is well known; I only remind you of it. But the discovery of the electron and of the structure of the atom is beginning to throw some light even on this process. We know now (or think we know) that an atom is a kind of solar system of electrons, in which they are revolving round a nucleus in a certain number of selected stable orbits; and we have reason to think that they only radiate when they drop from one orbit to another. The nature of the orbits, and the laws of electron motion in the atom, have now been elucidated, chiefly by the genius of Prof. Bohr, of Copenhagen, whose theory has been confirmed to a surprising extent and in astonishing detail by elaborate spectrum analysis; that is, by exact and metrical analysis of the radiation emitted. By means of that radiation the electrons in different kinds of atoms have been counted; the province of chemistry has been invaded by physics; and our views as to the constitution of matter have been immensely enlarged and in some respects revolutionised.

In speaking on matter and radiation one cannot but refer, however briefly, to these great developments of twentieth century physics. But the Radio Society, as such, is not concerned with small waves, nor with what goes on in the interior of atoms, except that it utilises the electrons which are thrown off by heated matter to confer rectifying power upon a valve.

Apart from that, a radio engineer deals mainly, not with individual electrons, but with the crowd of loose electrons which exist in a metal; his phenomena and his instruments are of a visible and tangible size. When he throws electrons into oscillation they do not quiver individually like a bell; they surge like a great crowd, rushing along and propelling themselves against an elastic barrier, the insulating ether. The elasticity of the ether throws them back again, when

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they have reached the end of their journey, along a conductor, and they surge to and fro for a time like a panic-stricken crowd. It is not panic but magnetism that keeps them moving. Their momentum is due to the inertia of the ether, in the shape of the magnetic field which surrounds them. So they rush in a current through their position of equilibrium, and pile themselves up at the other end of the conductor, to be thrown back again by electric elasticity once more. Oscillations are always due to the interaction or combination of elasticity and inertia.

We in this Society deal, therefore, with events on a large scale, involving enormous numbers; just as we do in machinery when we deal, not with atoms, but with millions and billions of atoms. The number of atoms in a piston-rod or a fly-wheel must be reckoned in trillions or quadrillions; the number of electrons which are surging in a wireless aerial is of the same order. When we drive machinery we do not attend to what the atoms are doing or how they are constituted, and when we send out radio waves we need not know exactly what the electrons are doing. We do not even know exactly why they are loose in a metal; whether they are wandering about in it like a sort of gaseous atmosphere quite detached from the atoms, or whether they are quickly passed from hand to hand, as it were, like fire buckets. For all practical purposes they are loose, but no final judgment has been pronounced as to the reason of this practical looseness. There are many partial theories of metallic conduction; very ingenious, but outside our scope to-day. We know that even in a metal the loose electrons are not quite free of the atoms, because they jostle them; they make the atoms shake as they rush by, so that a wire conveying a current can get red hot. Their energy, therefore, in an ordinary conductor is soon dissipated—rubbed down into heat.

But this kind of frictional dissipation does not seem essential. If a metal is cooled down to near absolute zero, so that its atoms are still and quiet—frozen, as it were, into position—the electrons are not frozen—not at all; they are as mobile as before. But now they no longer jostle the atoms; their paths seem clear and open. So that a current started in such a metal does not lose energy, is not rubbed down into heat, but continues by its own magnetic momentum for hours or days, or even a week.

All this is very instructive for those whose business it is to study atomic processes and realise what electric conduction is really like, but for practical purposes it is not necessary to understand or contemplate all that. Sufficient knowledge about conduction for practical purposes is embodied in the law of Ohm, the simple law which says that current is proportional to the force which propels it—a law quite analogous to Newton's second law of motion. In fact, electricity obeys many of the laws of matter, and we see good reason for that now, because we have learnt that matter is electrically composed.

Production of Radiation.

But how do we generate radiation, and what is radiation? Radiation is purely an etherial phenomenon: it is a pulsation or vibration or quiver or tremor in the ether. How can matter generate waves in the ether? A tuning fork can generate waves in air—any musical instrument can—but not in ether. There is no mechanical connection between ether and matter. I have tried to carry ether along by spinning a steel disc at the utmost speed, and it won't go; there is no handle or grip. Mechanical motion and ether are independent. There is no viscosity, no friction. However dense the ether may be—and I hold that it is enormously dense—it has no viscosity, and in no way affects locomotion. That is why it is so difficult to experiment on; and that is why things move so freely. That is why the earth can spin for ever, and why the planets can move without propulsion and without loss. The only link between matter and ether lies, not in mechanics, but in electricity and magnetism.

An electric charge is an etheric thing. It is concentrated on an electron, that is, on a constituent of an atom, but its field extends into the ether without limit. Electric charge is the connection between the two things—the matter nucleus and the ether field—and thus we get elastic recoil.

When a charge moves it develops magnetism; lines of magnetic force surround its path. They, too, are in the ether. Magnetism is wholly etheric; its lines do not end on material nuclei—they do not end at all. They are closed rings surrounding the paths of electronic locomotion; they are linked on

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to such paths, they confer momentum. There lies the other connection.

But neither an electric charge nor yet a magnetic field generates radiation. You must have both, an electric and a magnetic field superposed, at right angles to each other. Then you get radiation, travelling with the velocity of light, at right angles to both. This, when properly stated, is called Poynting's Theorem—an outcome of Clerk Maxwell's work.

How do we get this combination, this electromagnetic combination? An electric charge is all electric; a steady electric current is practically all magnetic. But if you suddenly change the speed of a moving charge, if you suddenly vary a current, if you suddenly move or stop an electron, or suddenly reverse its motion, then an electromagnetic wave starts out. Radiation is produced by changing the velocity of electrons—by accelerating or retarding them—and in no other way. This theory we owe to Sir Joseph Larmor: it is developed in his book "Aether and Matter" (published in 1900). It is the foundation of our modern knowledge about radiation.

In his theory centripetal acceleration, with no change of speed, but only change of direction, will do equally well—will equally well generate radiation. That I venture to doubt; I think there must be change of speed. Bohr's theory of the atom certainly suggests that, though without explanation. I expect to see Larmor's theory modified in that direction; but at present what I say is unorthodox.

Meanwhile we know that there is a reciprocal action; a sudden jerk of an electron generates a wave; that same wave can cause a similar jerk in another electron. All this is studied under the head photo-electricity: I daresay there will be a society some day for the special study of that; for I anticipate it will prove of great importance.

Photo-Electricity.

Atoms when properly jostled not only emit radiation, they may emit electrons. Any metal, if clean, ejects electrons when stimulated by the right kind of radiation, that is radiation of the right frequency: and to each metal belongs a certain characteristic frequency. Metals like gold and silver do not lose substance when exposed to light, any more than treasury notes do: they have to be exposed to X-rays before they respond. But light metals like potassium and sodium respond to ordinary light; and so, fortunately, does something in the retina of the eye. These substances fling away electrons at a characteristic speed when they feel luminous tremors: and it is to that strange and at present hardly accountable emission that vision is due; but for this we should not be able to see. I doubt very much if the electric tremors affect the nerves directly; they stimulate something specially adapted to respond to the vibrations. It is as if the eye contained three different substances, each of which responds to its own particular frequency—its own particular length of wave; thus giving us the means of detecting what our mind interprets as three different colours, red, green and violet: of these three-colour sensations it is known that all colour impressions are compounded.

But what is it that stimulates the nerves at all? I believe that it is the electrons, which are thrown off by the atoms with considerable violence. The energy with which the electron is thrown off depends on the substance, and on the kind of light which can stimulate that substance; it does not depend on the intensity of the light. No matter how feeble the light, the response is the same: the only difference is that feeble light can only stimulate a few atoms, a strong light can stimulate a great number. But an exceedingly feeble light makes some respond, and that is why the eye is so tremendously sensitive. The nerves have not got to appreciate the ether tremors directly: what the nerves feel is the shock of the ejected electron, which strikes them with a speed of some thousand miles a second. This is the theory of vision which is in process of being born, and which I feel sure contains the clue that has to be worked out by physicists and physiologists in combination. The eye is like a receiving instrument for detecting radio waves of extremely short and definite wavelength: it was the first wireless receiving instrument employed by man; nor by man only, but by nearly all the animals. Vision is a photoelectric phenomenon. I make that rash statement, and say that the burden of proof, and especially the burden of disproof, rests upon future experimenters.

Nor do animals alone possess this property. Vegetation possesses it too: not in the form of an eye, for there are no nerves to be stimulated, any more than there are in a photographic plate: the result in their

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case is not vision but chemical action. The stimulus of radiation, throwing out the electrons from atoms of matter, causes rearrangement among the molecules, chemical rearrangement. In any of these photo-electric cases the formation of images may result, that is to say the formation of patterns which our mind can interpret as images, just as it can interpret the scattered spots made by a process block; but the formation of images is a secondary result, not due to the radiation or the atoms directly, but to external optical devices, such as lenses; which alter the distribution of the incident radiation, concentrating it in some places, and diminishing it in others, so as to give a pattern of light and shade, a sort of line or spot engraving—it may be of a temporary, it may be of a permanent character. The formation of the pattern belongs to optics; it is no part of the primary result.

Vegetation has no optical appliances, and there is no pattern. But the green leaves of trees and plants contain a substance which responds chemically to light, and it is owing to this primary chemical response that sap is elaborated, vegetable tissue formed, and trees can grow. The growth of vegetation I believe to be a photoelectric phenomenon. And this view is strengthened by the now known fact that plants can be stimulated, not only by radiation, but by the discharge of electricity in their neighbourhood. Electrical stimulus probably achieves directly what ether waves achieve indirectly, that is to say, a rearrangement of the electronic constituents of atoms.

I made many experiments at one time (which have never been published) of the photoelectric response of ~~different kinds of~~ plants. Leaves of trees, if insulated and connected to an electroscope, certainly become charged, either with positive or negative electricity as the case may be, when submitted to ultra-violet light. That being so, depend upon it that they have learnt, so to speak, how to utilise sunshine in this way and adapt it to their own purposes. The growth of vegetation, like photography and vision, is, I believe, a photoelectric phenomenon.

Thermionics.

Thermionic emission is another branch of the subject, one which we owe mainly to Professor O. W. Richardson, though it was begun by Frederick Guthrie long ago, and, as everyone knows, it has been admirably applied by Professor Fleming and others in the rectifying valves, which are now almost domestic implements in many homes.

Thermionic emission, though analogous to photoelectricity, is rather different; it is not so exact and economical and precise a process. Heat is an irregular jostling; the atoms are thrown into vibration or clashed together, and the result is that a hot body not only radiates, but throws away electrons too. The electrons flung off from a hot body do not seem to emerge with any characteristic velocity, but with every kind of velocity. It is more like the emission of atoms from the surface of a warm liquid, or indeed from any liquid—the process known as evaporation.

There appears to be nothing electric about ordinary evaporation; it seems like a mechanical process. Some molecules are jostled and pitched out, while others enter and take their place; evaporation and condensation are always going on. When the atmosphere is thoroughly damp, evaporation does not cease; it is only balanced by equal condensation. It is just like radiation in that respect. In a room of uniform temperature the objects in it are in equilibrium, not because they cease to radiate, but because they receive as much as they emit. Radiation is going on from every piece of matter, until it is at absolute zero. An evaporating liquid may emit more molecules than it receives; in that case it will be losing weight. It may receive more than it emits; in that case it will be getting heavier. But the interchange is continuous. So it is in radiation. The interchange between matter and ether is always going on. Every piece of matter is emitting waves and also receiving them. If it emits more than it receives it is getting cooler; if it receives more than it emits it is getting warmer. Unless, indeed, it makes use of the received radiation for chemical or other purposes, so that the energy takes some form other than that of heat.

Thermionic emission is a kind of electrical evaporation. In your vacuum valve you keep the filament hot in order that electrons may evaporate from it. Above it you keep a positively charged anode, not hot at all, which is ready to receive electrons, but not to emit them. So the stream can only go in one direction; hence you get an action like that of a valve. A valve is something that lets a procession through one way, but

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not the other; like a mouse-trap, or the valve of a pump. Hence, with such a valve, you can rectify the oscillations stimulated by received ether waves, accumulating all those of one sign and rejecting those of opposite sign. Some crystals are able to do this without a vacuum, for reasons best known to themselves; and so you have crystal rectifiers, which you can use as receivers in the process of converting the fearfully rapid ether pulsations into the moderately rapid vibrations which can be utilised by a telephone and which affect the ear as a more or less musical note.

Radio Telephony.

But, as all the members of this Society know, Dr. Lee de Forest saw a way to improve Fleming's vacuum valve by introducing a regulator of traffic in the procession of electrons, in the shape of a grid; that is to say a sort of policeman who sometimes stops the traffic and sometimes lets it through. And by this means he enabled the valve to do more than rectify, to do more than would suffice for dots and dashes of the Morse code; the grid enabled or compelled the electrons to follow every fluctuation, to give all the peculiarities appropriate to different kinds of musical instruments, to follow with precision the consonants and vowels of human speech, and to reinforce or magnify their strength.

It is a very simple device, one that seems natural enough now: just as the telephone is a very simple invention. The marvel to me is, not so much that the electrons can be controlled and made to follow all the infinitely various modifications of speech and music, but that an iron plate can do it. All that the iron plate really does is to vibrate as it is compelled; big, small, quick, slow—whatever the forces inflicted on it are—it responds to them all. There are a few it doesn't like: it fails to discriminate clearly between "f" and "s"; but for the most part it responds with precision. It does not attempt any analysis; it imparts to the air all it gets: and whether we are reciting Shakespeare or reproducing the imaginations of Beethoven, they have to exist for a time in the curious mechanical inorganic unintelligent unconscious form of quivers in an iron plate and condensations and rarefactions in the air. No analysis is attempted till it reaches the ear: there in our head we have a receiving organ to which is imparted these same vibrations; but associated with the drum and its mechanical mechanism is a marvellous instrument, the inner ear, which analyses the movements into its components and imparts the appropriate stimulus to the fibres of the auditory nerve: it analyses the acoustic vibrations, as the eye analyses the optical vibrations: one is an air instrument, the other is an ether instrument.

But whence comes the interpretation? How do we get back from this confusion of movements (which in the intermediate stage is nothing but movement), how do we get back to the ideas of Shakespeare or Beethoven? Here we leave the ground of physics and physiology: we enter on the domain of psychology, and, as far as I know, we have no clear answer. All we can say (or at any rate all I can say) is that if our minds are superior to those of animals and savages, if they are not hopelessly beneath the scope of the mind which formed those conceptions, then somehow or other our mind is stimulated to receive some fraction of them, and to realise something of their creator's intention. We are, as it were, mechanically, or it may be electrically (which is the same thing), put into touch with minds greater than, but in some respects like our own. And thus it is that, on a lower level, ordinary human speech and intercourse is all conducted. Mind can speak to mind, but (as some think) only through the intervention of mechanism.

That is a position that can be controverted—a controversy upon which I do not now enter. I only point out that the ordinary process, to which we have grown accustomed, contains much that is mysterious, much that we hardly understand, very much that is astonishing; and I suggest that a direct mental communication, without mechanical intervention, may some day seem simpler, easier, and more natural.

Radiation Possibilities.

Now let us go back to the connection between radiation and matter, and to the electric units of which matter is composed.

Electric units are not all of one sign: they are positive and negative. There are electrons and also protons. When they come near together they tend to neutralise each other's outside influence; that is why ordinary matter is electrically neutral. A little friction will disturb and separate them, but they will get together again as soon as they can. Whenever they approach

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each other, falling together, they radiate, for their speed is obviously changing. The more violent the clash, the more vigorous the radiation. Do they ever actually inextricably clash, and annihilate each other? It is not known that they ever do; there seems to be something that keeps them apart, though they get very close together. Things on the earth seem too staid and quiet to allow of an actual destructive clash, or anything like mutual extermination. But the operation is conceivable, and as we now know that some of the stars have a temperature to be reckoned in millions of degrees, strange and violent things may be going on there. Perhaps some day they will be made to go in a laboratory, on a very small scale.

We can at least contemplate the process and ask what would happen if they did; the answer is clear enough. The two opposite charges would vanish in a puff of radiation; all that would persist of them would be their energy; there is no destroying that. The energy would be no longer localised in specks of matter, but would be travelling across space with the speed of light; it would now wholly and obviously belong to the ether. This process it is to which astronomers make appeal for the intense radiation from stars, and especially the unimaginably intense radiation in their interior, which distends them by its pressure as a football bladder or a motor-tyre is distended by the compressed air inside. It is not compressed air in the stars, it is compressed light; the pressure of light may become enormous, though here we have the utmost difficulty to detect it. Anyhow, some special process has to be imagined to account for solar or stellar radiation of this violence, enduring without perceptible loss for millions and billions of years.

But if the units of matter thus clash and destroy each other, matter must be disappearing. There is conservation of energy, there is no conservation of matter. What is matter at one moment may become radiation at another. Dr. Jeans tells us that the sun loses 4,000,000 tons of matter every second. That is the rate at which is is radiating ether waves—converting matter into ether energy and radiating it away. The data are simple enough, the arithmetic is easy, anyone can check the calculation. Four million tons a second it is. Of it the earth receives the equivalent of about two and a-half hundredweight a minute; but the earth radiates nearly as fast as it receives. Four million tons a second sounds a lot, but it makes no perceptible difference to the sun. It can go on expending itself at that rate for millions of centuries without any obvious change. In time, of course, it must exhaust itself and fade, but that time is not yet.

Much more might be said on that subject, but not now. What I want to ask is, is there any reciprocity about this process? Matter can turn into radiation. Can radiation turn into matter? I surmise that it can, but not under ordinary conditions. I guess that the waste radiation careering through space from all the innumerable suns and through innumerable millenniums must have some result. I imagine them to be generating matter in the far depths of space; which matter can then by gravitation fall together and reproduce or keep in maintenance the whole material cosmos. I see no ultimate dissipation of energy in the universe. I see energy passing from matter to ether and back again. That process, in simple form, we constantly experience—emission on the one hand, absorption on the other. Energy is always passing from matter to ether and back again. The energy of matter is called kinetic; the energy of ether is called potential. All activity is the result of interchange—transference and transmutation of energy.

Ether Theory.

But now note that if an electron can for any reason have its beknottedness untied and be converted into ether, it must be really composed of ether all the time. I have no doubt that it is. An electron is peculiar or modified ether, and so is a proton. But electrons and protons together constitute an atom of matter, and atoms of matter constitute the whole of what we see and handle, the objects around us, and the planets and the stars. Is matter, then, a peculiarity or modification of the ether? That is exactly what I think is the truth. The object of physics in the long run will be to explain all material phenomena, first in terms of electricity and magnetism, and then those in terms of ether. I look forward to the time when we shall realise that the whole of the material universe, and all the phenomena we are acquainted with, are ether in different kinds of motion. Not locomotion, but spinning motion, vortex motion; the kind of

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motion elaborated by the genius of Helmholte. Such a structure for the ether began to be considered in an optical connection by McCullagh, of Dublin, was taken up by G. F. FitzGerald, was elaborated by Lord Kelvin, and also by Prof. W. M. Hicks, ultimately taking a form which has been called " a vortex sponge"—an incompressible, absolutely continuous medium, full of excessively fine-grained vorticity ; able to transmit transverse waves, and presumably able to be modified here and there into the peculiar configurations which we have not yet fully learnt to understand, but which we have named electrons and protons.

There is more to be said, though probably I have now said enough, and have taken you rather far from the daily exercise of wireless signalling, about the recent developments of which you know quite as much, and probably more than I. But I should just like to say, briefly, that there is reason to believe that the ether is not only of enormous density, but also is under a gigantic pressure, 10^{33} dynes per square centimetre, and that this it is which holds the electron together, in spite of the self-repulsion of its electric charge. Poincaré and Langevin, between them, have shown that this theory will account for the size of an electron and put it in equilibrium. And we know that its electric field accounts for its apparent mass. What we do not yet understand is the remarkably greater extra mass of the proton. Why should that be 1,840 times as heavy as an electron ? What does this number, 1,840 or 1,845, mean ? Is it really an exact number ? I think it must be. I make a guess that the electron is hollow, an ether vacuum, its electric charge just compensating the pressure and preventing collapse. That guess can be justified if an ether vacuum is allowed. What has become of the material extracted ? I guess that it has been jammed into the nucleus of the proton, and that somehow it is going to account for the strange and at present empirical number 1,845.

Conclusion.

I leave you in a region of speculation. There is no time to justify or elaborate these suggestions ; some are not ripe for elaboration, others are. It is true that modern physics contains a great deal of inevitable speculation, but it is not rash and random speculation ; it is all of the nature of working hypothesis based upon half-understood facts, and it clamours to be tested by experiment and observation. Speculation is comparatively useless until it can be made definite, so that it can be tested ; but if it suggests experiment it is of high value. Indeed, we cannot do without it unless we are pursuing the regular course of orthodox dynamics, which, as you know, in the hands of Newton and his great disciples carried us very far, but which has now begun to show signs, not of weakness, but of lacunæ, gaps, or interstices, which it is our business to fill up. A framework or scaffolding is a most useful structure, but it does not pretend to be the complete edifice. It does not fill in the minuter details. In physics we do not deal only with the gross and tangible things which affect our senses ; we seek to penetrate the atoms, we enquire into the properties of the connecting medium. Matter is excessively porous, here a particle, and there a particle, with great spaces between ; it is not really the continuous substance it appears. When we deal with the infinitely small, dynamics begins to fail us ; new and extraordinary entities force themselves on our attention. Predicates have to be quantified in a new and unusual sense. Matter resolves itself into discontinuities, and these are unintelligible without a continuous ether uniting them.

There is any amount to say about the ether, but not now. All we are concerned with now is its power of transmitting waves. That alone shows that it has metrical properties. These waves are intimately associated with matter ; we have recently learnt how to produce and how to detect them. Most of us leave the production to others ; we only annoy people when we emit them—they call it howling—but reception is easy. You hang out a material wire, containing lots of loose electrons, in the ether of space, and straightway the waves are collected and brought into the house. Whether you detect them or not, there they are. Like many other things amid which we live, we might be ignorant of them. We should know nothing about them had we not taken the trouble to receive them, to prepare means, and to listen in, as an act of faith.

Whether as generators or as receivers, it might be said that the whole object of this Society is—a better understanding, and a more efficient utilisation, of the recently discovered and fundamental connection between Matter and Radiation.

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THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

A Stable Super-Heterodyne Receiver.

THERE are several advantages to be derived by using a resistance-coupled high-frequency amplifier in a super-heterodyne receiver. Suitable resistances are quite cheap, they are easily connected in the circuit, and no difficulty is experienced in securing effective amplification, provided a reasonably high wavelength is employed. Perhaps the most important of the advantages, from the point of view of telephony, however, is the fact that such an amplifier does not distort the signals when properly adjusted.

Distortion may, of course, be caused by sharply tuned circuits. When tuned circuits are employed and the amplifier is adjusted to a fairly high wavelength, such as 10,000 metres, distortion due to the sharpness of the tuned circuits is almost bound to be caused, more especially when the signals are strengthened by employing reaction. The higher notes are weakened, and the resulting speech or music is low toned. When anode resistance couplings are employed, this type of distortion does not occur, provided the values of the resistances, grid condensers, grid leaks and grid bias are correctly chosen.

It would therefore seem to be ideal to employ a resistance-coupled amplifier, but it should be remembered that the amplification obtained is not quite so high as when a well-built transformer-coupled amplifier is employed, and that a higher anode voltage is required. The amplification can be brought up to the desired level by adding another valve, and the cost of the extra anode battery is practically negligible compared with the expense of the valves themselves; but there is another serious drawback. A resistance-

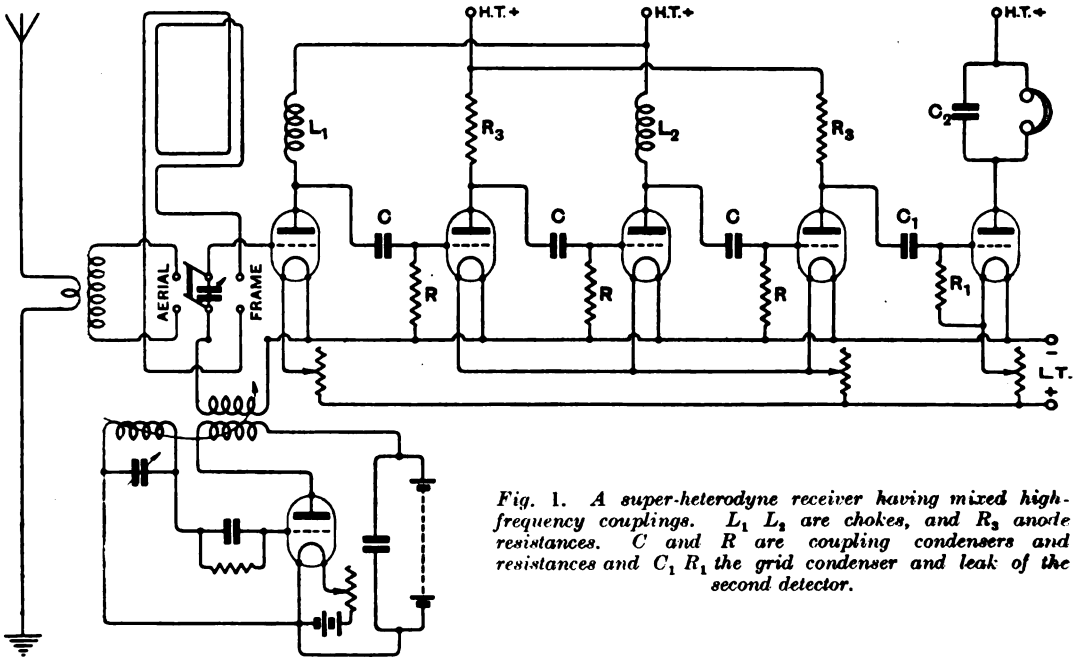

Fig. 1. A super-heterodyne receiver having mixed high-frequency couplings. L_1 L_2 are chokes, and R_3 anode resistances. C and R are coupling condensers and resistances and C_1 R_1 the grid condenser and leak of the second detector.

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coupled amplifier is usually noisy; that is, there is a background of noise which is usually of sufficient intensity to spoil moderately strong signals, and to render the weaker signals unintelligible. The noise may be reduced considerably, and some of the advantages of this form of coupling retained by employing mixed couplings, as indicated in Fig. 1, where two of the anode circuits have resistance couplings. With this arrangement noises are not amplified to any great extent, the circuit is stable, and usually does not give trouble through self-oscillation. Further, there are only the two circuits to be adjusted to the same wavelength, namely L_1 and L_2.

This type of circuit does not appear to be extensively employed, partly, I think, because its advantages are not sufficiently well appreciated. It is one which I can recommend from experience with several super-heterodyne receivers. Probably only those who have tried to stabilise an amplifier with three stages (four circuits) of tuned transformer or tuned anode amplification appreciate the difficulty in preventing howling and in cutting out long wavelength interference.

Reflexing a Super-Heterodyne Receiver.

Many of the commercial super-heterodyne receivers have one or two stages of reflex amplification, and there is nothing to prevent one from doing this with satisfactory results, provided care is taken in choosing the components employed, and in properly arranging them in the circuit. It should be remembered that the wavelength of the H.F. portion of the circuit is considerably higher than many are accustomed to deal with. For instance, if the wavelength of the H.F. amplifier is 10,000 metres, the frequency is 30,000 cycles, which compares with an average frequency of about 750,000 cycles for broadcasting, and the highest audible frequency of about 7-10,000 cycles.

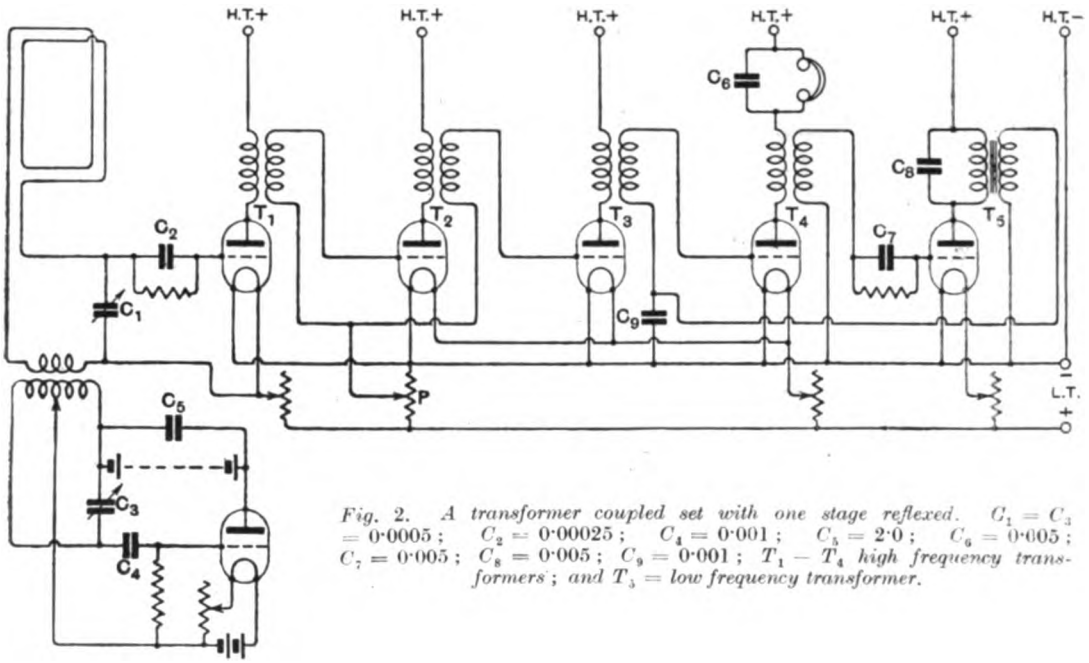

Fig. 2. A transformer coupled set with one stage reflexed. $C_1 = C_3 = 0{\cdot}0005$; $C_2 = 0{\cdot}00025$; $C_4 = 0{\cdot}001$; $C_5 = 2{\cdot}0$; $C_6 = 0{\cdot}005$; $C_7 = 0{\cdot}005$; $C_8 = 0{\cdot}005$; $C_9 = 0{\cdot}001$; $T_1 - T_4$ high frequency transformers; and T_5 = low frequency transformer.

I have tried the circuit of Fig. 2, having the values given in the caption, with satisfactory results. Only one stage is shown reflexed, as usually distortion is produced when a second valve is so connected. A second stage, of course, may be usefully employed to strengthen weak signals, but when the signals are of good strength I prefer to employ an additional valve of the power type as an amplifier. If a valve having ample emission and a low impedance is employed, the quality and strength are usually very much better than when a second valve of the H.F. amplifier is reflexed. It is, of course, advantageous to reflex the valves when filament and anode current have to be kept at as low a value as possible.

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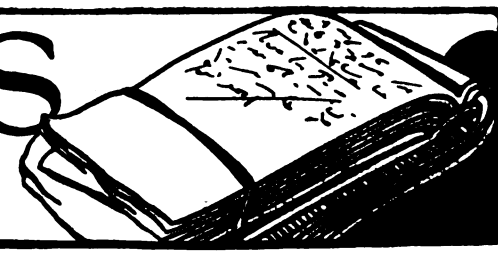
NOTES & NEWS



KDKA, the well-known Pittsburg broadcasting station, is reported to have been heard in the Bismarck Archipelago, north of New Guinea, a distance of over 9,000 miles.

* * * *

The new broadcasting station at Moscow transmits on a wavelength of 1,200 metres and employs a power of one kilowatt.

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Mr. R. L. Royle, of Palmers Green, London, effected two-way communication with Australian 3BQ on January 20th.

* * * *

A listener at Jesselton, North Borneo, claims to have heard the chimes of Big Ben broadcast from 2 LO.

* * * *

Major H. Lefroy, J.P., who was prominently associated with Army wireless during the war, has been appointed a director of Marconi's Wireless Telegraph Co., Ltd.

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The Director-General of the German Railways, Herr Oeser, states that wireless telephony apparatus is to be installed on all express trains.

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ENGLISH ANNOUNCEMENTS FROM PORTO RICO.

That announcements from WKAQ, the San Juan broadcasting station, Porto Rico, are made in English as well as Spanish, has been discovered by Mr. K. R. Crawshaw, a Halifax reader. Unless reception is very clear, however, it is quite easy to imagine that the whole announcement is in Spanish, states Mr. Crawshaw, owing to the strong Spanish accent. WKAQ, which operates on 360 metres, was picked up by our correspondent on a three-valve receiver (1— v—1).

MR. FLEWELLING'S SHORT WAVE TESTS.

Daily transmissions on 64 metres are being carried out by Mr. E. T. Flewelling (9 XBG), of circuit fame, from his station at Chicago. Music is transmitted from midnight until 12.30 a.m., followed by C.W. and telephony until 12.45 a.m. Mr. Gordon Ritchie, of Glasgow, states that he received faint music from 9 XBG on January 13th.

HEARD IN ALL CONTINENTS.

In having his signals picked up in South Africa, Mr. F. L. Hogg (2 SH), of Highgate, is now able to claim that his transmissions have reached every continent. The South African amateur who received 2 SH towards the end of last year is Mr. L. G. Hughes, of Johannesburg, who describes the experience in an interesting letter. 2 SH was first heard on 120 metres but has subsequently been well received on 90.

According to Mr. Hughes, very few British amateurs can be heard in Johannesburg, whereas little difficulty is encountered in picking up quite a number of Americans. As in all tropical countries, atmospherics are the bane of the wireless man in South Africa, and Mr. Hughes states that he can draw sparks ¼ in. to ½ in. long when manipulating the earth switch !

At the time of the above transmission, Mr. Hogg was employing a power of under 80 watts with raw A.C.

MIDDAY RECEPTION OF U.S.

Mr. S. K. Lewer (6 LJ), of West Hampstead, states that he has recently been receiving signals from many of the 1st District American amateurs as late as mid-day ; he has also heard them as early as 6.30 p.m.

SCANDINAVIAN TRANSATLANTIC TEST.

A morning test between American and Swedish amateurs, organised by *Radio-Bladet*, and under the control of the American Relay Radio League, was carried out from 7 to 9 a.m. on Sunday, February 1st. The Americans undertook the transmission side of the test, whilst the Scandinavians endeavoured to " log " as many Americans as possible in the time at their disposal.

The checking arrangements were in the hands of the A.R.R.L. and we understand that two prizes are being awarded, one to the American who was most widely heard, and one to the Scandinavian amateur who picked up the greatest number of American stations. The result of the test has yet to be announced.

AUSTRALIA WORKED DURING ECLIPSE.

During the recent solar eclipse some very fruitfu experiments were carried out by Mr. E. J. Simmonds (2 OD), of Gerrard's Cross, Bucks, in the course of which he succeeded in communicating with Australian 3 BQ and in picking up signals from New Zealand, 4 AK. This, of course, was during the afternoon, whereas the usual times for receiving

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Australian and New Zealand amateurs are the early evening and early morning respectively.

From 2 p.m. onwards 2 OD sent out regular signals at intervals of ten minutes, with a special code word which was changed with each transmission. These transmissions were received by Capt. Arison, of Edinburgh, who compiled an interesting graphical record demonstrating that signals steadily increased in volume until the eclipse had reached its maximum.

At 3.40 p.m. GHH (Mosul) was heard strongly, and at 4.15 p.m., shortly after the eclipse had reached a maximum, New Zealand 4 AK was heard at a strong and steady strength, but although communication was attempted, 2 OD received no response. A call came, however, from A 3 BQ, and contact was at once established, good signals being exchanged. In the course of the conversation, 3 BQ mentioned that 45 minutes previously he had been in touch with U 6 ABK, this also being an unusual time for such a communication. The New Zealand station was again heard by 2 OD at 4.50 p.m., working with GHH.

It is interesting to note that in all cases the signals were unusually clear and steady.

Several other readers picked up Australian stations during the eclipse.

TELEPHONY TESTS FROM SCHENECTADY.

Simultaneous morse transmission on 100 and 30 metres is being carried out every Saturday-Sunday night by 2 XI, the General Electric Company's station at Schenectady, states Mr. J. Gordon Ritchie, of Glasgow. The times of these transmissions are from 11 p.m. to 3 a.m., and from 5 a.m. to 7 a.m. Reports, which should be as full as possible, are invited, and will be acknowledged by radio. We understand that on January 10th several English amateurs' reports were acknowledged in this manner, including those from 5 DN, 2 NM and 2 KF.

2 XL intends "going on the air" with telephony on 100 metres early in the present month, and reports on this are specially desired.

AN OPPORTUNITY FOR PHOTOGRAPHERS.

Wireless enthusiasts who are also photographers will learn with interest that by arrangement with *The Amateur Photographer*, photographs of general wireless interest may be submitted to the editor of that journal with a view to their forming cover illustrations for *The Wireless World*. Photographs accepted for this purpose will be paid for at the rate of two guineas. Details of this scheme, which also applies to photographs accepted for the inside pages of *The Wireless World* at the rate of half-a-guinea, will be found in the current issue of *The Amateur Photographer*.

FRENCH AMATEUR'S TESTS.

A regular transmitting schedule is being adhered to by French YZ, of Colombes, Seine, who transmits on 150 metres at the following times (G.M.T.):—Daily, except Sunday, for thirty minutes, at 2.30 p.m., 4.30 p.m., 6.30 p.m. and 8.30 p.m. On Tuesday, Thursday and Saturday, from 4.30 p.m., till midnight; on Wednesday, Friday and Sunday, from 5 a.m. to 7.30 a.m.

Reports, which would be much appreciated, should be addressed to F. Lecroat, 2 Rue de Bournard, Colombes, Seine

CHEAPER VALVES.

Our readers will welcome the important announcement that the prices of Marconi Osram valves have undergone a further reduction. The following is a schedule of the new prices, which came into operation on February 2nd.

Type.	Present List Price.	New List Price
"R"	12/6	11/-
"R5V"	12/6	11/-
"DER"	21/-	18/-
"DE3"	25/-	21/-
"DE4"	30/-	26/-
"DE5"	35/-	30/-
"DE5B"	35/-	30/-
"DE6"	25/-	22/6
"LS5"	55/-	50/-

Calls Heard.

Eastbourne, Sussex. (January 1st to 10th.)
French: 8 BF, 8 BN, 8 DP, 8 EU, 8 ÉU, 8 FK, 8 FOK, 8 FZ, 8 GI, 8 GK, 8 RG, 8 RQ, 8 RZ 8 SG, 8 UU, 8 WK, 8 WL, 8 ZB, 8 ZUE, 8 ZUT. American: 1 BHM, 1 MY, 2 AZY, 2 BGB, 2 CJX, 2 WX, 3 ADE, 3 BDO, 8 XB, NKF. Italian: 1 AM, 1 CF, 1 CXM, 1 KX. Dutch: 0 BU, 0 MR, 0 NL, 0 RE. Swedish: SMXX, SMZU. Finnish: FN 1NA. Danish: 7 ZM. Unknown: 3 CM, 9 CS, 4 AB, 3 WB. (A. Roach.)

Felixstowe, Suffolk.
French: 8 CA, 8 CL, 8 COA, 8 CO, 8 CS, 8 FP, 8 HE, 8 JBL, 8 NC, 8 RB, 8 RH, 8 RJ, 8 SSU, 8 TT, 8 XH, 8 XX, 8 ZW. Dutch: 0 AD, 0 AZ, 0 CS, 0 MA, 0 MC, 0 QR, 0 RN, 0 WP, 0 ZA. American: 1 GB, 1 OZ, 1 TZ, 2 DY. Finnish: 3 DV. Canadian: 1 AR. Argentine: DA 8. (All below 200 metres.) (R. T. Frost.)

Lower Broughton, Manchester.
French: 8 AB, 8 AÉ, 8 AAA, 8 BV, 8 CZ, 8 EM, 8 FK, 8 GG, 8 GI, 8 GP, 8 GS, 8 SG, 8 SM, 8 SSV, 8 SSU, 8 UU, 8 XU, 8 ZZ. Dutch: 0 AD, 0 BA, 0 RE, 0 LA, 0 NL, 0 ZN. Swiss: SMXX; Belgian: 4 SS. Danish: 7 ZM, 7 GQ. American: 1 AD, 1 AG, 1 AX, 1 ANA, 1 ARE, 1 ARY, 1 AXZ, 1 BDT, 1 CA, 1 CM, 1 CEI, 1 ERI, 1 HN, 1 SF, 1 VJ, 2 AG, 2 AW, 2 BY, 2 BM, 2 CB, 2 WL, 3 CH, 3 CBR, 7 BDS, 8 TR. (W. Clough.)

Catheart, Glasgow. (January 1st to 15th.)
British: 2 CC, 2 DX, 2 HS, 2 KZ, 2 KW, 2 NM, 2 NN, 2 OC, 2 OD, 2 RB, 2 SZ, 5 LS, 5 MO, 5 NN, 5 TZ, 5 OK, 6 FA, 6 FG, 6 GH, 6 LJ, 6 NF, 6 TD. French: 8 AAA, 8 BF, 8 BV, 8 BN, 8 CS, 8 DP, 8 ÉN, 8 ÉU, 8 EU, 8 ÉM, 8 FC, 8 FJ, 8 GV, 8 GN, 8 GK, 8 HS, 8 HSG, 8 MT, 8 MN, 8 NS, 8 RG, 8 SM, 8 SSU, 8 SSV, 8 TK, 8 VP, 8 VTI, 8 WAL, 8 WK, 8 WU. Dutch: 0 BQ, 0 NL, 0 LL, 0 RE, 0 REU, 0 ZN. Belgian: 4 UC, 4 AX, P 2. Swiss: 9 AD, 9 BR, 9 LA. Italian: 1 AM, 1 FC, 1 RE. (o—v—o Reinartz, indoor aerial.) (A. T. Wilson.)

Whimple, Devon.
French: 8 AAA, 8 AB, 8 AL, 8 AMZ, 8 AQ, 8 AVF, 8 BAP, 8 BF, 8 BO, 8 BP, 8 BRG, 8 CA, 8 CK, 8 CM, 8 CO, 8 CPP, 8 DKV, 8 DL, 8 DY, 8 ÉM, 8 ÉN, 8 ÉV, 8 FC, 8 FG, 8 FMA, 8 FQ, 8 FY, 8 GGA, 8 GH, 8 GI, 8 GK, 8 GO, 8 GP, 8 HS, 8 HSF, 8 HSM, 8 II, 8 JV, 8 LPR, 8 NB, 8 NS, 8 SPR, 8 SSC, 8 SSM, 8 SSU, 8 SSV, 8 TM, 8 UU, 8 WAL, 8 WK, 8 XR. Belgian: 4 AX, 4 RS, 4 SS, 4 YG. Dutch: 0 AA, 0 GG, 0 KC, 0 LL, 0 MS, 0 NF, 0 RE, 0 RZ, 0 ZN. Italian: 1 AM. Swedish: SMZY. Swiss: 9 AA, 9 AB. Finnish: 2 NM, 2 NC. Danish: 7 QF. British: 2 ASH, 2 DR, 2 FN, 2 IL, 2 JX, 2 KW, 2 LH, 2 OD, 2 VQ, 2 WV, 2 WY, 5 CS, 5 MO, 5 NN, 5 OM, 5 QR, 5 SA, 5 VQ, 6 LJ, 6 NF, 6 NH, 6 QB, 6 RM, 6 TD, 6 TM, 6 US. (o—v—o and o—v—1.) (G. F. FitzHerbert.)

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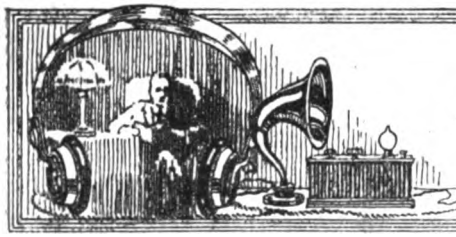

AMONG THE SOCIETIES.

The headquarters of the Kingston and District Radio Society are now at Kingston Lodge, London Road, and meetings are held regularly on Mondays at 8 p.m. On February 9th a Social Evening is to be held to which all wireless enthusiasts in the district are invited.

* * * *

A forthcoming visit of Captain P. P. Eckersley is announced by the Ilford and District Radio Society. The Chief Engineer of the B.B.C. will speak at the Ilford Town Hall on March 26th, the meeting being open to the public at popular prices. In order to cope with the large attendance which is expected it is understood that "Marconiphone" loudspeakers will be installed.

* * * *

On January 22nd Mr. J. A. Partridge, more familiarly known as "2 KF," gave an extremely interesting lecture before the Beckenham and District Radio Society, taking as his subject: "Short Wave Transmission and Reception." Various types of aerial, their advantages and disadvantages, were discussed in detail, after which the lecturer dealt with the best circuits for pure reception. The Society is making arrangements to hold an exhibition at an early date. A feature of the exhibition will be a competition for home constructors.

* * * *

The manufacture of condensers was treated in an informative lecture given before the Tottenham Wireless Society on January 16th, by Mr. Hayward, of the Dubilier Condenser Co. By means of a series of lantern slides the members were able to watch the processes of condenser manufacture from the mica mines in India to the product as it leaves the factory.

On January 21st Mr. Tracey provided an instructive lecture on "Set Design and Lay-out," in which useful hints were given as to the best positions for components in different circuits. Mr. Tracey raised an important point which is often forgotten. In the construction of a valve set it is advisable first to decide what type of valve is to be used, and then to design the set to suit the valve.

* * * *

The Dublin Wireless Club is conducting a series of lectures specially for beginners.

On Thursday, January 22nd, an interesting loud speaker demonstration was given with a four-valve receiver constructed by members of the club. In order to render the wiring easily visible the components were mounted on a board. The construction and working of the set were thus explained so as to be understood by all members.

* * * *

At the fourth annual meeting of the Kensington Radio Society held on January 15th, various useful suggestions were put forward with a view to making the Society's monthly meetings still more attractive. Several of these were adopted and it is hoped that as a result, attendances will grow.

Mr. F. L. Hogg (2 SH), of Highgate, London, photographed in his "den." Signals from 2 SH have been heard in every continent.

FORTHCOMING EVENTS.

WEDNESDAY, FEBRUARY 4th.

Institution of Electrical Engineers—Wireless Section. At 6 p.m. (light refreshments at 5.30 p.m.). At the Institution, Savoy Place, W.C.2. Lecture: "The Optimum Damping in the Auditive Reception of Wireless Telegraph Signals." By Mr. L. B. Turner, M.A., and Mr. F. P. Best, M.Sc.

Radio Research Society, Peckham. Discussion: "Rejector Circuits." Lecture: "Wavemeters."

THURSDAY, FEBRUARY 5th.

Luton Wireless Society. At 8 p.m. At the Hitchin Road Boys' School. Lecture and Demonstration: "Fault Finding on Wireless Instruments." By Mr. C. S. Dunham.

FRIDAY, FEBRUARY 6th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Department of Applied Science, St. George's Square. Ordinary Meeting.

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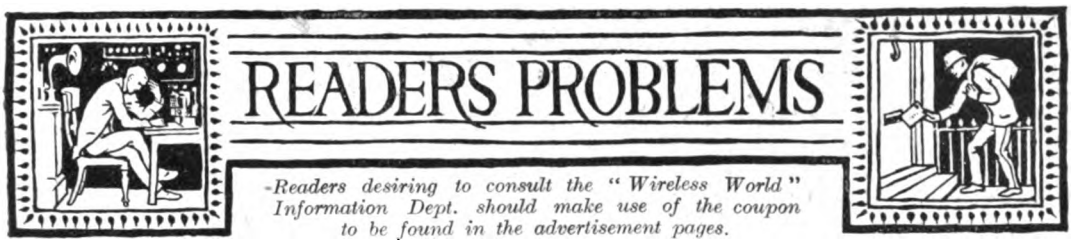
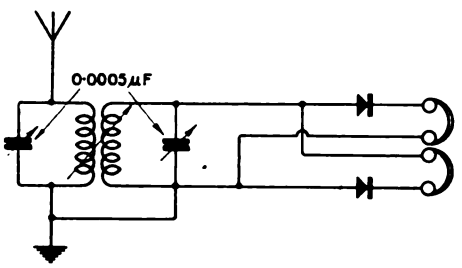

READERS PROBLEMS
-Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.

METHODS OF OBTAINING INCREASED EFFICIENCY FROM CRYSTAL SETS.

A READER asks for a selective crystal circuit, in which each half cycle of the oscillatory current in the tuner circuit can be made to energise different pairs of telephones.

We illustrate below a circuit suitable for accomplishing this. Two pairs of telephones are used, and it will be found that, using this method, the signal strength in each pair of telephones is equal to that in the telephones of a conventional circuit, using one pair only. A single pair of telephones may be used if desired by connecting each individual earpiece in the position occupied by each pair of telephones in the diagram.



A special crystal receiver.

Another method is to employ two telephone transformers with their input windings individually connected in circuit with one crystal. The output windings can now be connected in series with each other and with a pair of telephones. When using several pairs of telephones in conjunction with a crystal set it will usually be found that better signal strength will be obtained if each pair of telephones is operated in conjunction with a separate crystal, the various pairs of telephones and their associated crystal all being connected in parallel across the tuning inductance.

EFFICIENCY OF ACCUMULATOR CELLS CONNECTED IN PARALLEL.

A READER who is intending to abandon the use of bright emitter valves in favour of dull emitters of the 2-volt type, has asked whether it would be better to obtain large capacity accumulators of the single cell type or to connect the three cells of a 6-volt accumulator in parallel. He also wishes to know if this type of valve can be considered equally efficient to those valves requiring 4 to 6 volts to operate them.

It is usually found to be far better to employ a separate 2-volt cell to operate these valves rather than to utilise the cells of a 6-volt unit connected in parallel. The reason is that when cells of any type are connected in parallel there is almost sure to be a certain amount of inter-action set up due chiefly to the varying potentials of the individual cells of the unit. This is more noticeable in the case of dry cells connected in parallel than with secondary batteries. If the cells of a 6-volt accumulator are used separately care must be taken that all are fully charged before an attempt is made to connect them in parallel. Otherwise, if one is fully charged and another is not, there will be a current discharge from one to the other.

With regard to dull emitters of the 2-volt class it may be said that they are equal in every respect to their bright emitter prototypes for all ordinary work. Provided that those 2-volt valves, such as the D.E.6, which are specially designed for the work, are used, they give most excellent loud speaker results.

THE USE OF INDOOR AERIALS.

FROM time to time we receive requests for advice on the best type of indoor aerial to employ from readers who, by reason of dwelling in a flat or some similar cause, find themselves unable to make use of the conventional type of outdoor aerial.

The actual design of aerial which can be used depends, of course, on the space which is available for the erection of an indoor aerial. Probably the most efficient indoor aerial which can be erected is that consisting of two widely spaced parallel wires stretched in the loft of a house and running the entire length or breadth of the building. Usually better results will be obtainable by using two widely spaced wires than if a greater number of wires with closer spacing were employed, but this is, of course, a matter for individual experiment. Very often it will be found that with an aerial of this type results obtainable fall very little short of those experienced with the conventional type of outdoor aerial. In the case of many aerials which one sees erected a few inches above a lead roof or running parallel and in close proximity to the gutter spouting,

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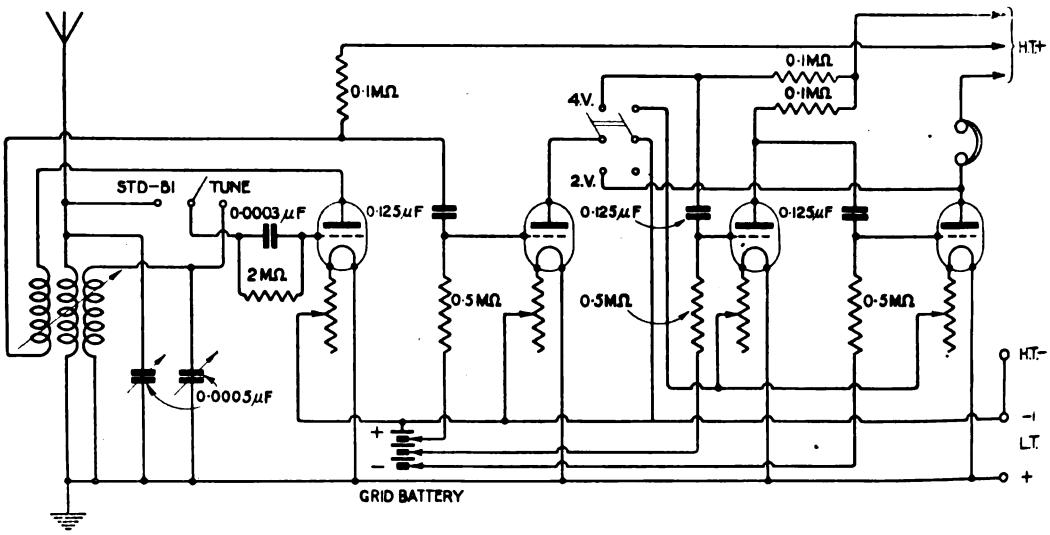
better results could probably be obtained by the use of an indoor aerial.

In many houses, of course, a loft is non-existent, and in these cases an aerial has to be erected elsewhere. If possible it should be erected in an upper room and be of as great a length as possible. Usually it will be found that a long single wire tretched the full length of a passage is more effective than several short parallel wires stretched across a single room, but here again no hard and fast rule can be drawn. Turning to the question of more or less "freak" aerials, such as the use of the electric light mains, there is much scope for experiment. The results obtained from the electric light mains vary so much in different houses that one hesitates to go to the expense of purchasing one of the special adaptors sold for this purpose when it may be quickly found quite useless. This type of aerial can, however, be easily tested out by wrapping a piece of tinfoil round one of the electric globes and attaching it to the aerial terminal of the set. It is sometimes found that the use of the electric bell wiring gives better results than are obtainable from the lighting mains. Connection may be made to either of the contacts in the ordinary electric bell push, and no fear of damage to the bell system need be anticipated. It may be found that good results are obtained from the telephone system. In order to use this method there is no need to tamper with the telephone connections in any way, or otherwise to infringe the regulations of the postal authorities. Provided that the desk type of telephone is fitted all that need be done is to place the telephone on a metal tea tray, the tray itself being connected by a wire to the aerial terminal of the set.

A FOUR-VALVE RECEIVER GIVING GOOD SELECTIVITY AND HIGH QUALITY REPRODUCTION.

WE have received a letter from a correspondent living midway between three of the B.B.C. stations, asking for a wiring diagram of a selective four-valve set which will give the utmost purity and which is stable and easily controlled. He wishes to use resistance coupling for the L.F. valves if possible.

In order to meet the requirement of good selectivity, loose coupling is used, with a switch for changing over to direct coupling when required. As no high frequency amplification is employed, the set will not be unstable when using loose coupling. The first L.F. amplifier can be of the type having a high M value, such as the D.E.5 B. The final valve should not in any case be of this type, and if very strong signals are expected to be delivered to the grid of the second amplifier, this should also be of a type similar to the final valve, but in cases where weak signals are being received it may be of the D.E.5 B. type. A common H.T. tapping is given for the first and second amplifiers, but separate grid bias is provided, so that if valves of the D.E.5 B. and D.E.5 type are used in these respective positions, both anode voltages will be similar, but with, of course, separate values of grid bias. A switch is provided for cutting out the last two valves when headphone reception is desired. It is not recommended that the usual grid leak type of resistance be used in the anode circuits. Wire wound resistances, similar to those described on page 379 of the December 17th issue of this journal will be found to give very much better results.



A four-valve receiver having a valve detector and three stages of resistance-coupled low-frequency amplification.

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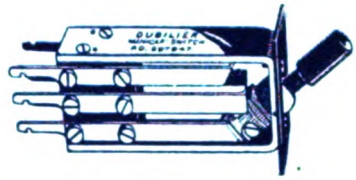
DUBILIER PRODUCTS



THE "MINICAP."

Every serious experimenter or constructor should number amongst his accessories at least one double-pole double-throw switch.

The uses for such a switch are numerous and varied.

With its aid can be compared the reproduction from different telephones, loud speakers, detectors, transformers, circuits or even complete sets, and, since the change-over is instantaneous, the comparison is far more effective than when numerous leads have to be changed.

Further uses are those of switching in and out steps of high or low frequency amplification, changing over from "series" to "parallel" adjustments, from "tune" to "stand-by," etc., etc.

In some of the instances mentioned, a small capacity between the various contacts of the switch is not harmful; in other cases, such as in H.F. circuits, it is imperative to eliminate self-capacity wherever possible.

The Dubilier MINICAP (minimum capacity) switch has been designed with the object of ensuring that no undue capacity effects occur in the switch itself.

It can be mounted on the panel of a set if it is to be fixed permanently in one position, or, for experimental work, it may be mounted on a separate panel of its own and provided with terminals. In this way it becomes one of the most useful pieces of apparatus on the experimenter's bench.

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469	2	600	640— 1,050	6/6
470	3	900	950— 1,600	6/9
471	4	1,300	1,400— 2,500	7/-
472	5	2,500	2,600— 4,000	8/6
473	5 (A)	4,000	4,200— 6,500	9/-
474	6	6,200	6,300— 8,600	9/6
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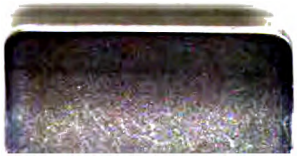

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